Developing Consistent Regulations for Three Seasonally Closed Areas off Puerto Rico: Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank

Public Hearing Draft

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Abbreviations and Acronyms

ACL	annual catch limit
AM	accountability measure
APA	Administrative Procedures Act
BVI	British Virgin Islands
CEA	cumulative effects analysis
CEQ	Council on Environmental Quality
CFMC	Caribbean Fishery Management Council
CZMA	Coastal Zone Management Act
EA	environmental assessment
EC	ecosystem component species
EEZ	exclusive economic zone
EFH	essential fish habitat
ESA	Endangered Species Act
FEIS	final environmental impact statement
FIS	Fishery Impact Statement
FMP	fishery management plan
FMU	fishery management unit
HAPC	habitat area of particular concern
HMS	Highly Migratory Species
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MMPA	Marine Mammal Protection Act
MSY	maximum sustainable yield
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OMB	Office of Management and Budget
OY	optimum yield
PRA	Paperwork Reduction Act
PSU	practical salinity units
RFA	Regulatory Flexibility Act
RIR	Regulatory Impact Review
SEFSC	Southeast Fisheries Science Center
SEIS	supplemental environmental impact statement
SERO	Southeast Regional Office
USVI	United States Virgin Islands

Regulatory Amendment 5

to the Fishery Management Plan for the Reef Fish Fishery
of Puerto Rico and the U.S. Virgin Islands

Regulatory Amendment 1

to the Fishery Management Plan for the Spiny Lobster Fishery
of Puerto Rico and the U.S. Virgin Islands

Framework Adjustment

under the 2006 Consolidated Atlantic Highly Migratory Species
Fishery Management Plan

Proposed actions:

Establish consistent regulations among three managed areas off the west coast of Puerto Rico to facilitate enforcement while ensuring appropriate protection for resident spawning aggregations and the habitats that support those aggregations.

Lead agencies:

Caribbean Fishery Management Council
National Marine Fisheries Service

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Table of Contents

List of Figures

List of Tables

Chapter 1. Introduction

1.1 What Actions are Being Proposed?

The Caribbean Fishery Management Council (Council) is proposing to modify the fishery management regimes for Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. The overarching goal of this proposed modification is to establish consistent regulations governing the three areas as a means of ensuring protection of spawning aggregations of reef fish and benthic habitat. An additional objective of the proposed action is to achieve regulatory consistency among the three areas, thereby facilitating enforcement of those regulations.

Within that overarching goal, the Council proposes six actions. Action 1 proposes to modify the timing of the established seasonal fishing closures to enhance protection of known reef fish spawning aggregations in an effort to achieve a more natural sex ratio, age, and size structure, while minimizing adverse social and economic effects. Actions 2 and 3 propose to modify the reef fish and spiny lobster fishing activities, respectively, within Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. Action 4 proposes to prohibit anchoring in order to protect benthic habitats, including pristine coral stands. Action 5 proposes to modify the Atlantic highly migratory species (HMS) fishing activities within the three managed areas. Atlantic HMS are not managed by the Council so the Council would make recommendations to the HMS Management Division of the National Marine Fisheries Service (NMFS) who would have the authority to implement any recommended modifications. Action 6 proposes to modify the spearfishing regulations within the three areas.

Caribbean Fishery Management Council

- Responsible for conservation and management of fish stocks
- Consists of seven voting members
  - Four voting members appointed by the Secretary of Commerce
  - One voting member appointed by each of the Governors of Puerto Rico and the U.S. Virgin Islands (2 total)
  - The Regional Administrator of NMFS for the Southeast Region
- Manages the area from 3 to 200 nautical miles (nm) off the coasts of the U.S. Virgin Islands and 9 to 200 nm off the coast of Puerto Rico
- Develops fishery management plans and recommends regulations to NMFS and the Secretary of Commerce for implementation

Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank are known to be composed of pristine coral habitats (García-Sais et al. 2007; García-Sais et al. 2010) that support these

aggregations and which also serve as residential, recruitment, and foraging habitat for these and a variety of other economically and ecologically important species. The Council is striving to ensure adequate protection of these areas in order to preserve the current spawning fish populations and the habitat conditions that support these aggregations.

In December 2010, the Council increased the seasonal fishing closure of Bajo de Sico from three months to six months (October 1 through March 31) to provide greater protection of commercially important reef fish. Additional modifications allowed fishing for spiny lobster and HMS within federal waters of Bajo de Sico. Since then, the need to have consistent regulations for all three areas has been expressed to the Council in order to avoid confusion among fishers, enforcement agents, and other user groups.

Bajo de Sico and Tourmaline Bank both include portions in federal waters as well as Puerto Rico Commonwealth waters. The Bajo de Sico area consists of about 60% federal waters, while the Tourmaline Bank area consists of approximately 40% federal waters. The actions proposed in this document, and the analyses associated with those proposed actions, only pertain to the federal portions of these areas. Currently, Puerto Rico does not have seasonal closures for the Commonwealth portion of these three areas. However, the Council will request the government of Puerto Rico to implement compatible regulations if the proposed actions in this amendment are approved by the Secretary of Commerce (Secretary) and implemented in federal waters.

1.2 Who is Proposing Action?

The Council is proposing the action. The Council develops the action and proposed regulations and submits the regulatory amendment to the Secretary. If the Secretary determines the regulations are consistent with the fishery management plan (FMP), the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), and other applicable laws, the Secretary approves the regulations for implementation and publishes the proposed rule in the *Federal Register* for public comment. After the public comment period, NMFS addresses any comments and publishes the final rule, thus making the regulations effective.

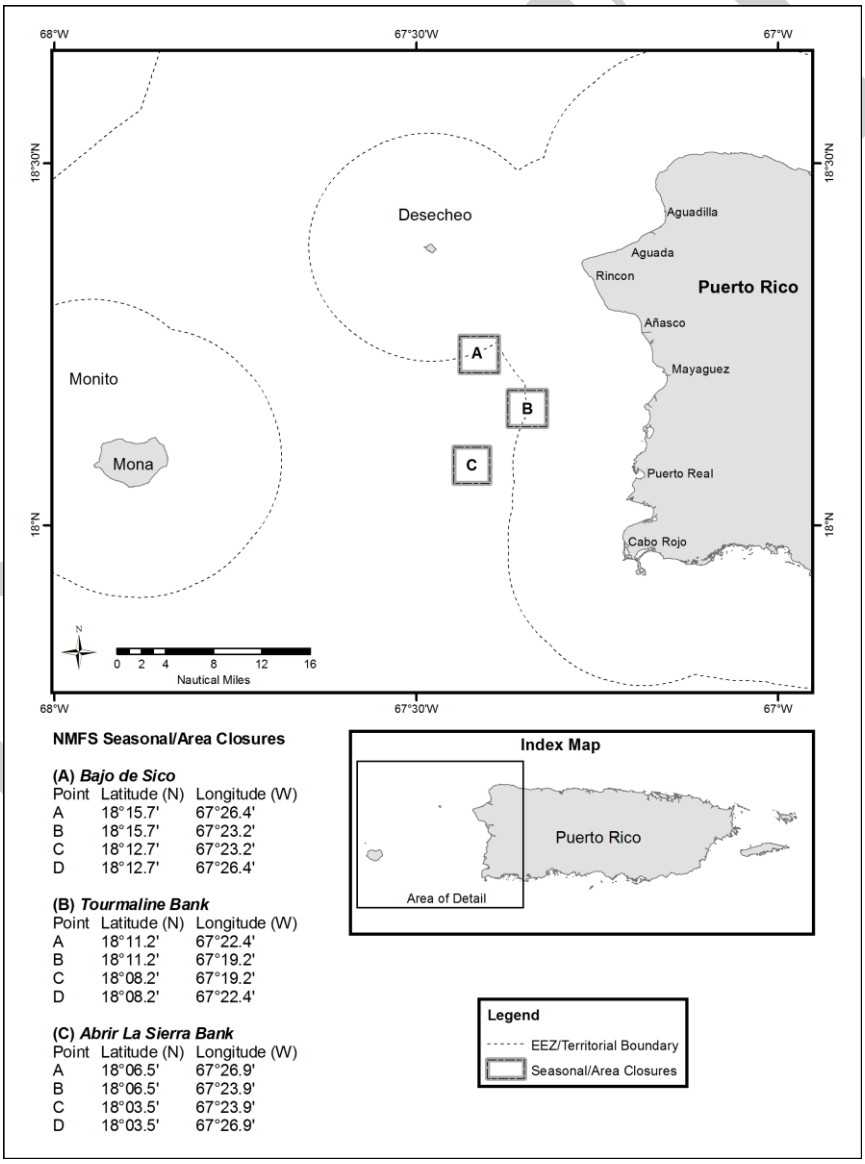
Who's who?

- NMFS and Council Staff – Develop alternatives based on guidance from the Council, and analyze the environmental impacts of those alternatives.
- Caribbean Council – Determines a range of actions and alternatives, and recommends action to NMFS.
- Secretary of Commerce – Approves, disapproves, or partially approves the amendment.

1.3 Where is the Project Located?

The three areas for which modifications are being proposed are located off the west coast of Puerto Rico (Figure 1.3.1). Tourmaline Bank was first established in 1993 through Amendment 2 to the FMP for the Reef Fish Fishery of Puerto Rico and the U.S. Virgin Islands (USVI) (Reef Fish FMP; CFMC 1993). In 1996, Regulatory Amendment 2 to the Reef Fish FMP (CFMC 1996) modified the size of Tourmaline Bank and established Abrir La Sierra Bank and Bajo de Sico.

Figure 1.3.1. Three seasonally closed areas on the west coast of Puerto Rico: Bajo de Sico, Tourmaline Bank and Abrir La Sierra Bank



1.4 Why is the Council considering these actions?

The three managed areas and associated regulations were originally implemented to protect spawning populations of red hind. Since the establishment of the managed areas, red hind stocks have increased in size and abundance, ostensibly due to protection of these spawning aggregations. But, scientists have recently discovered spawning aggregations of snappers and other groupers, as well as nearly pristine deep-water (i.e., mesophotic) coral reef formations, within these areas (García-Sais et al. 2007; García-Sais et al. 2010; García-Sais et al. 2013; Appeldoorn & Schärer-Umpierre unpublished manuscript). Mesophotic reef systems, such as those found within Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank, serve as recruitment, residential, foraging, and spawning aggregation habitats for a variety of commercially and recreationally important reef fishes and shellfish, as well as sea turtles. For example, reef tops in Bajo de Sico are believed to be the main residential habitat for a healthy population of Nassau, yellowfin, and yellowmouth groupers, schoolmaster, yellowtail, dog and cubera snappers, large adult spiny lobsters, and hawksbill turtles (García-Sais et al. 2010; Schärer-Umpierre et al. 2013; Tonioli and Agar 2009). Similarly, evidence suggests that deep rhodolith reefs provide foraging habitats for queen triggerfish and residential habitats for red hind and an assemblage of small reef fishes that are important in the aquarium trade (García-Sais et al. 2010). Fish populations inhabiting these three areas could also contribute larvae for distribution to other areas in the U.S. Caribbean. For example, during the mutton snapper spawning aggregation event at Abrir La Sierra Bank in May 2009, García-Sais et al. (2010) measured water currents that could transport and disperse fertilized eggs and early larvae towards the west-northwest coast of Puerto Rico and Mona Passage.

Purpose and Need

- The purpose of this amendment is to establish consistent regulations governing the three target areas as a means of ensuring protection of spawning aggregations of reef fish and the benthic habitat supporting those aggregations, which also serves as residential, recruitment, and foraging habitat for a variety of species.
- There is a need to modify the seasonal closures to ensure continued and consistent provision of the important ecological services they provide, including recruitment, residential, foraging, and spawning aggregation habitats for commercially and recreationally important reef fish and shellfish, as well as sea turtles. There is also a need to establish consistency among the three managed areas to facilitate enforcement and avoid confusion among constituents.

Investigations by García-Sais et al. (2007) described Bajo de Sico populations of snappers and groupers as composed of relatively large individuals, many of which exhibited behaviors indicating they were approaching a spawning condition (i.e., sexual dimorphic color patterns and aggressive behaviors normally associated with spawning). Red hind, yellowfin, yellowmouth, Nassau, and black groupers were observed to be common in both Bajo de Sico and Abrir La Sierra Bank (García-Sais et al. 2007; García-Sais et al. 2010). Mutton, blackfin, dog and cubera snappers, red hind, hogfish and queen triggerfishes were the most abundant of the large, commercially important species observed within the mesophotic habitats of Tourmaline Bank (García-Sais et al. 2013). Herbivores were not highly abundant, but were represented by a species-rich assemblage that included parrotfishes, doctorfishes, and damselfishes within sample transects. García-Sais et al (2010) also observed a species-rich assemblage of wrasses, basses, grunts, gobies, puffers, hawkfishes, hogfishes, squirrelfishes, morays, triggerfishes and small groupers such as coneys, graysbys, rock hind and red hind. The high concentration of schooling zooplanktivorous fish species associated with mesophotic reefs attract large pelagic reef predators, including the great barracuda, king and cero mackerels, and large jacks. Pelagic migratory fish predators, such as the wahoo, dolphin fish, dorado, blackfin, skipjack and yellowfin tunas, and marlins, also forage upon schooling reef fishes and their smaller pelagic predators (García-Sais et al. 2010; Tonioli and Agar 2009).

1.5 History of Management

The Council is one of eight regional fishery management councils, established under Public Law 94-265 (approved on April 13, 1976), now known as the Magnuson-Stevens Act as amended in 1996 and 2007, for the conservation and orderly utilization of the fishery resources of the United States of America.

The Council is responsible for the development of FMPs in the U.S. Caribbean Exclusive Economic Zone (EEZ) off Puerto Rico and the USVI. The Council submits FMPs and plan amendments to the U.S. Secretary for approval and implementation in the EEZ. Upon implementation of the FMPs, local Governments may adopt compatible legislation in local waters.

The Council manages 179 fish stocks under four FMPs:

- FMP for the Spiny Lobster Fishery of Puerto Rico and the USVI (Spiny Lobster FMP);
- FMP for the Reef Fish Fishery of Puerto Rico and USVI (Reef Fish FMP);
- FMP for the Corals and Reef Associated Plants and Invertebrates of Puerto Rico and the USVI (Coral FMP); and
- FMP for the Queen Conch Resources of Puerto Rico and the USVI (Queen Conch FMP).

1.5.1 Spiny Lobster

The Council implemented the Spiny Lobster FMP (CFMC 1981; 49 FR 50049) in January of 1981, supported by an environmental impact statement (EIS). The FMP defined the Caribbean spiny lobster fishery management unit (FMU) to include *Panulirus argus*, described objectives for the management of the spiny lobster fishery, and established management measures to achieve those objectives. Primary management measures included in the FMP were:

1. **Allowable Spiny Lobster Harvest and Management Reference Points:**

    - Defined the maximum sustainable yield (MSY) for the spiny lobster fishery at 830,000 pounds (lbs) per year, which is the greatest amount or yield that can be sustainably harvested under prevailing environmental conditions. The Council estimated MSY for each of the three individual areas (Puerto Rico, St. Thomas/St. John, and St. Croix), then summed those individual MSY's to derive a U.S. Caribbean-wide MSY. The MSY was 610,000 lbs per year for Puerto Rico, 116,900 lbs per year for St. Thomas/St. John, and 102,400 lbs per year for St. Croix;
    - Defined the U.S. Caribbean-wide optimum yield (OY) as "all the non-egg-bearing spiny lobsters in the management area having a carapace length (CL) of 3.5 inches (in) or greater, that can be harvested on an annual basis." The Council estimated the OY to be in the range of 582,000 to 830,000 lbs per year. An OY of 582,000 would apply for the first year following FMP implementation, adjusted in subsequent years as a function of (1) planned rebuilding of the biomass, (2) variability in habitat, and (3) better assessment data. Moreover, the CL size limitation of 3.5 in ensured that most lobsters have reproduced at least once prior to harvest and provided a safeguard against overfishing. Therefore, harvest exceeding the upper limit of 830,000 lbs in any given year was not expected to result in damage to the resource;
    - Established a domestic annual harvest (DAH) under the proposed CL of 3.5 in. The DAH ranged between 582,000 lbs and 830,000 lbs per year. The Council concluded that U.S. Caribbean domestic fishermen had the capacity to harvest the entire DAH leaving no surplus of spiny lobster available for foreign fishing.

2. **Size and harvest requirements:**
    - Land lobster whole and with a CL larger than 3.5 in;
    - Prohibits retention of egg-bearing (berried) lobsters (berried female lobsters may be kept in pots or traps until the eggs are shed), no stripping or removing the eggs from a lobster, undersized lobster may be kept in the fish pots as attractors but may not be harvested.

3. **Gear Requirements:**
   - Include a self-destruct panel and/or self-destruct door fastenings on traps and pots to eliminate "ghost traps". These self-destruct panels would allow spiny lobsters to escape from traps that have been lost;
   - Identify and mark traps, pots, buoys, and boat. The Council implemented this measure to aid enforcement, resolve social conflicts, and provide data on fishermen mobility and effort;
   - Prohibit the use of poisons, drugs, or other chemicals, and use of spears, hooks, explosives, or similar devices to take spiny lobsters, reducing injury to lobsters that if landed would be illegal to retain;
   - Require trip specific catch and effort statistics be reported through existing data collection systems.

4. **Fishery Management Unit**
   - Defined the U.S. Caribbean spiny lobster stock, although the question of whether or not biologically distinct sub-stocks of *P. argus* may be identified was not resolved;
   - For the purpose of the Spiny Lobster FMP, three biological assessments areas (distinguished by their user groups and geography) were assumed: (1) Puerto Rico, (2) St. Thomas and St. John, and (3) St. Croix;
   - A single OY was established. There is nominally one species and the source(s) of recruitment are not verified.

Amendment 1

The Council implemented Amendment 1 to the Spiny Lobster FMP (CFMC 1990a; 56 FR 19098), in May of 1991. Amendment 1 addressed the new requirements in the 1988 revision of the National Standards in the Magnuson Stevens Act. An environmental assessment (EA) and a finding of no significant impact (FONSI) supported the conclusions in this amendment.
Through Amendment 1, the Council implemented definitions for overfished and overfishing, outlined framework actions that could be taken by the Council should overfishing occur, and better described the habitat for the spiny lobster.

The amendment defined "overfished" as a biomass level below 20% of the spawning potential ratio (SPR). The SPR is the ratio of the level of reproduction at a given rate of fishing compared to the level of reproduction when there is no fishing. The Council's Scientific and Statistical Committee (SSC) selected the 20% SPR estimate as a level with an acceptable probability of protecting the stock biomass from long-term reductions or fluctuations in recruitment and yields. The Council's SSC defined "overfishing" as a harvest rate that is not consistent with a program implemented to rebuild the stock to the 20% SPR.

In addition, Amendment 1 established management measures to halt overfishing should overfishing occur. In order to modify regulations, the Council generally must follow the FMP amendment procedure, which takes longer to implement than if the Council had available a framework process. The framework

process includes a pre-determined set of management measures the Council can modify outside the FMP amendment procedure. These pre-determined management measures include:

- Implement closed seasons;
- Increase minimum carapace length;
- Limit the use of shorts;
- Require escape gaps in traps;
- Reduce the number of traps;
- Establish marine reserves.

Amendment 2

The Council implemented Amendment 2 to the Spiny Lobster FMP (CFMC 2005; 70 FR 62073), in 2005 as part of the Caribbean Sustainable Fisheries Act (SFA) Amendment. This comprehensive amendment included a final supplemental EIS (FSEIS), which examined the impacts of amending the Council FMPs to comply with several new provisions of the Magnuson-Stevens Act reauthorization of 1996. This amendment:

- Redefined as needed, based on the FMP objectives, FMUs and subunits that reflect those stocks of fish that were best managed individually and those stocks of fish that were interrelated and best managed as a unit or in close coordination;
- Defined biological reference points (MSY and OY) and status determination criteria for managed stocks to determine when a species is overfished;
- Reduced fishing mortality to levels consistent with the biological goals;
- Established a standardized bycatch reporting program;
- Minimized bycatch and bycatch mortality to the extent practicable;
- Described and identified essential fish habitat (EFH);
- Described and identified habitat areas of particular concern (HAPCs);
- Identified measures to prevent, mitigate or minimize to the extent practicable the adverse effects of fishing on EFH;
- Defined and described the fishing communities of the U.S. Caribbean.

Amendment 3

The Council published a notice of intent (NOI) to prepare a DEIS for Amendment 3 to the Spiny Lobster FMP in the *Federal Register* on October 9, 2007 (72 FR 57307). The proposed alternatives would consider measures to implement escape vents in the trap fishery sector. However, Amendment 3 was postponed until a pilot study could be conducted on the effective size of escape vents.

Amendment 4

The Council implemented Amendment 4 to the Spiny Lobster FMP (CFMC 2008; 74 FR 1148), in February of 2009 to restrict spiny lobster imports into the U.S. The Council established conservation standards to achieve an increase in spawning stock biomass and increase the long-term yield of the fishery. Limiting spiny lobster imports to a uniform minimum size that protects juvenile spiny lobsters would help stabilize the reproductive potential of the Caribbean spiny lobster by reducing the amount of juvenile spiny lobster mortality in foreign fisheries. Such action would result in the harvest of larger lobsters in exporting countries. This measure would increase the probability of dispersal of Caribbean spiny lobster larvae throughout the species' range.

Scientists state that the harvest of juvenile tails in other Caribbean countries affects the sustainability of U.S. lobster stocks because these harvesting countries produce the parental stocks and larvae for the U.S. stocks. In other words, if you destroy brood stock off the coast of the South American shore of the Caribbean Sea, you effectively destroy the fisheries of other countries, regardless of the management schemes in those countries. This aquatic resource is an example of a shared resource in that it has no national boundaries because of its dependency on the ocean currents for its larval distribution.

Amendment 4 also prohibited any person from importing spiny lobster less than 6.0 ounces tail weight to Puerto Rico or the USVI. If the imported product would not meet this minimum weight requirement, the person importing the lobster could demonstrate compliance by showing that the product imported satisfies the tail length requirement, or that it was harvested from an animal that satisfied the minimum CL requirement of:

a. Greater than or equal to 6.2 inches (15.75 cm) tail length if only the tail is present.
b. Greater than or equal to 3.5 inches (8.89 cm) CL if the animal is whole.

Amendment 5

The Council implemented Amendment 5 to the Spiny Lobster FMP (CFMC 2011b; 76 FR 82414) in January of 2011 as part of the 2011 Caribbean Annual Catch Limit (ACL) Amendment. This amendment addressed new requirements in the reauthorized Magnuson Stevens Act of 2007. New management measures implemented in this amendment included:

- Revised the management reference points and status determination criteria established in Amendment 2;
- Established ACLs and accountability measures (AMs) for spiny lobster;
- Allocated spiny lobster ACLs among island management areas;
- Established recreational bag limits for spiny lobster;
- Revised framework procedures for the spiny lobster.

1.5.2 Reef Fish

The Council implemented the Reef Fish FMP (CFMC 1985; 50 FR 34850) in September of 1985 to address decreasing catches of shallow-water reef fish reported in the U.S. Caribbean. The FMP was supported by an environmental impact statement (EIS) and established the following management measures:

1. **Fishery Management Units**
   - Defined the FMU to include 64 shallow water reef fish distributed among 14 families of the most commonly landed species in Puerto Rico and the USVI. These 64 species accounted for 60% of the total finfish landings in the area extending from shoreline to the edge of the insular platform.

2. **Management Reference Points**
   - Defined the MSY and OY to be 7.7 million pounds whole weight (mp ww) for the entire shallow-water reef fish FMU;
   - Concluded that local fishermen were harvesting 100% of the OY. Therefore, there was no remaining harvest designated for foreign fishing.

3. **Gear**
   - Established a 1 ¼ in minimum mesh size for fish traps to allow for the escape of juvenile fish;
   - Required a self-destruct panel (not smaller than the funnel opening of the trap) and/or self-destruct door fastening in fish traps. This panel would allow fish to escape ghost or lost traps;
   - Required owner identification and marking of traps, buoys, and boats in the EEZ, with allowance for:
     a. Marking/identification systems required by the Puerto Rico and USVI management agencies to be used by fishermen of those states to meet the federal marking requirements;
     b. If the state(s) eliminates the marking system or a fisherman will fish only in the U.S. Caribbean EEZ, an identification number and color code will be assigned by NMFS Southeast Regional Director upon application.
   - Prohibited the hauling or tampering of another fisher's traps without the owner's written permission, except by authorized enforcement officer, to reduce the theft of fish traps;
   - Prohibited the use of poisons, drugs, other chemicals, and explosives for fishing in the management area, as these practices do not discriminate between species or species sizes and are detrimental to the environment.

4. **Minimum Size Requirements**
   - Established an 8 in total length (TL) minimum size for yellowtail snapper the first year following implementation, increasing one inch per year until reaching 12 in TL. The Council implemented the minimum

size requirement in an attempt to halt the observed trend in decreasing average size of yellowtail snappers landed by the fishermen;

- Established a 12 in TL minimum size for Nassau grouper the first year following implementation, increasing one inch per year until reaching 24 in TL. This minimum size requirement was triggered by reduction in the Nassau grouper population.

5. Seasonal Closures

- The Council established a closed season for Nassau grouper to protect their spawning aggregations. Landings were prohibited from January 1 to March 31 of each calendar year; fish of this species caught during the closed season had to be returned to the sea immediately with minimum injury in such a manner as to ensure maximum probability of survival.

6. Data requirements

- Increased the collection of catch/effort and length/frequency data, as well as any necessary biological information, through improvement of the existing state-federal agreements formulated by NMFS/Puerto Rico/USVI data collection programs. Having this information available would allow the Council to better manage shallow-water reef fish species.

Amendment 1

The Council implemented Amendment 1 to the Reef fish FMP (CFMC 1990b; 55 FR 46214) in December 1990. The conclusions of this amendment were supported by an EA and a Finding of No Significant Impacts (FONSI).

The Council determined that more restrictive management measures were needed to achieve the goals of the Reef Fish FMP. Data from the Cooperative Fishery Statistics Program revealed a continued downward trend in species composition and volume of landings. For example, parrotfish (considered to be a second or third class market fish by the fishermen) was being sold as a first class fish, displacing the less abundant first class snappers and groupers. In addition, the red hind populations in Puerto Rico were also exhibiting a decline in average size. To address these issues, the Council implemented the following measures:

1. Gear Requirements

- Increased the minimum mesh size of fish traps from 1 ¼ in to 2 in to further reduce bycatch, including bycatch of juvenile fish and herbivorous fish essential to the maintenance of reef ecosystem balance;
- The reported landings of Nassau grouper declined to the extent that the Council closed the Nassau grouper fishery until the species could be rebuilt to sustainable levels;
- Revised the data collection efforts to include the collection of socio-economic information on the different managed fisheries;

- Established an annual December 1 through February 28 closed area (Hind Bank Marine Conservation District) southwest of St. Thomas where red hind harvest is prohibited. The amendment prohibited the use of any fishing gear capable of capturing reef fish, such as fish traps, hook and line, bottom nets, and spear.

2. **Management Reference Points**
   - The Council defined overfishing and overfished conditions for shallow water reef fish.
     - A reef fish stock or stock complex is overfished when it is below the level of 20% of SPR;
     - When a reef fish stock or stock complex is overfished, overfishing is defined as harvesting at a rate that is not consistent with a program that has been established to rebuild the stock or stock complex to the 20% spawning stock biomass per recruit level;
     - When a reef fish stock or stock complex is not overfished; overfishing is defined as a harvesting rate that if continued would lead to an overfished state.

3. **Essential Fish habitat**
   - Described the characteristics of the habitat used by the fish stocks included in the shallow water reef fish FMU.

4. **Framework Measures for the Reef Fish FMP**
   - Amendment 1 established management measures, which the Council could implement via the framework process. In order to modify regulations, the Council generally must follow the FMP amendment procedure, which takes longer to implement than if the Council had available a framework process. The framework process includes a pre-determined set of management measures that the Council can modify outside the FMP amendment process. These pre-determined management measures included: size limits, closed seasons or areas, fish trap mesh size, and the level of spawning stock biomass per recruit necessary to rebuild an overfished stock.

Regulatory Amendment 1

The Council implemented Regulatory Amendment 1 to the Reef Fish FMP (CFMC 1991; 56 FR 48755) in October 1991. This amendment was supported by an EA with a FONSI.

In 1998, Hurricane Hugo hit Puerto Rico resulting in many fishermen losing fishing gear. The Small Business Administration provided loans to fishermen to assist in replacing lost gear including fish traps. However, instead of buying the required 2 in mesh wire, fishers used square mesh wire of 1.5 in. The Council modified the 2 in minimum mesh size requirement to avoid further economic hardships to the fishermen. Therefore, the Council implemented the following requirements to compensate for the lack of smaller mesh size:

- Traps fabricated of bare hexagonal wire of 1.5 in smallest dimension or wire mesh of 2 in (bar measure) must have openings (8 x 8 in) on each of two opposing sides of the trap (excluding the top, bottom, and side with funnel opening). The fishermen were required to cover the 8 x 8 in openings with a panel of wire of a mesh size no less than that of which the trap is constructed and attached with untreated jute of a maximum diameter of 1/8 in. The access door may serve as one of the panels if it is hinged at the bottom and fastened with 1/8 in jute at the top so that the door would fall open when the fastener degrades. Jute used to secure the panels may not be wrapped or overlapped to extend degradation time;
- Traps constructed with square-mesh bare wire of 1.5 x 1.5 in must have openings of 9 x 9 in covered with a mesh panel of no less than 2-in square-mesh wire on each of two opposing sides of the trap (excluding the top, bottom and side with funnel opening) and attached as described above. The Council disallowed the use of all 1.5-in square-mesh wire in the fishery beginning September 14, 1993;
- All wire mesh measurements are from center of strand to center of strand in accordance with manufacturers' specifications;
- Plastic traps and vinyl-coated wire traps must conform to the same mesh measurements and escape panel requirements for bare wire traps. The dimensions of the mesh openings in plastic and vinyl-coated wire traps must be equivalent to the mesh opening specifications for bare wire traps.

Amendment 2

The Council implemented Amendment 2 to the Reef Fish FMP (CFMC 1993; 58 FR 53145) in November 1993, supported by a supplemental EIS (SEIS). The Council's desire to address decreasing abundance of fishery resources, protect spawning aggregations, and extend these protections to other reef fishes not presently included in the FMU led to the development of this amendment. For example, the Council had originally planned to develop a separate FMP for

the deep-water reef fish fishery but decided that an amendment to the shallow-water reef fish FMP was more practicable and economical. To address their concerns, the Council did the following:

1. **Fishery Management Unit**
   - Expanded the existing FMU to include deep-water reef fish to address their decline in landings;
   - Extended protection to the aquarium trade finfish species;
   - Prohibited the use of chemical substances or other destructive devices to harvest aquarium trade species, instead limiting allowable gear for collection of these species to hand-held dip nets and slurp guns;
   - Prohibited the harvest and possession of certain aquarium trade species;
   - Retitled the FMP from the Shallow Water Reef Fish FMP to the Reef Fish FMP of Puerto Rico and the USVI.

2. **Management Reference Points**
   - Applied existing definitions of MSY and OY to all reef fish within the revised FMU, with the exception of marine aquarium finfish;
   - The MSY and OY of marine aquarium finfish remained undefined.

3. **Gear Requirements**
   - Required that the fish traps be constructed as follows:
     - Basic construction material must be 1.5-in hexagonal mesh wire or 2.0-in square mesh wire;
     - The escape openings in the trap must be at least 8x8 in and located on any two sides (except top, bottom, or side containing the funnel);
     - The access door may serve as an escape opening provided it meets all the requirements for size and location, and is fastened in such a manner that the door will fall open when the fasteners (see below) degrade;
     - The panels covering the escape openings must be of a mesh at least as large as the mesh used in constructing the trap, and fastened with untreated jute twine 1/8-in or less in diameter when traps are fitted with zinc anodes; or fastened with 18-gauge ungalvanized wire or 1/8-in untreated just twine (maximum diameter) if anodes are not used.

4. Seasonal Closures

- Due to the drastic decline in their population, the Council implemented a prohibition on the harvest of Goliath grouper in the U.S. Caribbean EEZ;
- To protect red hind spawning aggregations, the Council established prohibitions on red hind harvest from December 1 through the end of February 28 each year within the Tourmaline Bank area off the west coast of Puerto Rico and the Lang Bank area off the east coast of St. Croix;
- The Council prohibited harvest of mutton snapper from March 1 through June 30 of each year within the Mutton Snapper Spawning Aggregation Area southwest of St. Croix.

Technical Amendment

The Council implemented this technical amendment to the Reef Fish FMP (59 FR 11560), in April 1994 to help clarify the minimum mesh size requirement for fish traps in the U.S. Caribbean EEZ.

The amendment modified the regulations regarding minimum allowable mesh size to be the distance between the centers of strands rather than the smallest dimension of the opening, consistent with industry standards. Fishermen were using coated–wire fish traps with mesh constructed of this standard size. The difference between the industry standard bare wire and coated wire is approximately 0.23 in (5.84mm) not considered significant for purposes of fishery conservation. The clarification included the following text:

> *.....Mesh size. A bare-wire fish trap used or possessed in the EEZ that has hexagonal mesh openings must have a minimum mesh size of 1.5 inches (3.8 cm), in the smallest dimension measured between centers of opposite strands. A bare-wire fish trap used or possessed in the EEZ that has other than hexagonal mesh openings or a fish trap of other than bare wire such as coated wire or plastic used or possessed in the EEZ must have a minimum mesh size of 2.0 inches (5.1 cm), in the smallest dimension measured between centers of opposite strands…*

Regulatory Amendment 2

The Council implemented Regulatory Amendment 2 to the Reef Fish FMP (CFMC 1996; 61 FR 64485) in January 1997. The amendment, supported by an EA and FONSI, reduced the size of Tourmaline Bank originally implemented in 1993, and established seasonal closures in two additional areas off the west coast of Puerto Rico (Abrir La Sierra Bank and Bajo de Sico).

The Council implemented this regulatory amenement, based on recommendations by the fishermen in Puerto Rico, to modify the boundaries of Tourmaline Bank. The fishermen argued that the red hind spawning aggregation was restricted to a 1.5 mile radius around Buoy 8 on Tourmaline Bank; areas west of this radius did not support the spawning aggregation. In addition, the boundaries precluded fishermen

from moving and storing fish traps in the sandy bottom of Tourmaline Bank during bad weather events. Furthermore, the Council considered the outcome of surveys showing continued decreases in the mean size of the red hind population. To address these issues, the Council closed the EEZ portions of the following three areas to all fishing between December 1 and the end of February of each year.

- A 1.5-mile radius centered around a buoy to be deployed in the area known as Bajo de Sico;
- A 1.5-mile radius around Buoy 8 at Tourmaline Bank (this is part of the area already closed but it allows for the use of the sandy area where red hind are not found);
- A 1.5-mile radius around Buoy 6 at Abrir La Sierra Bank.

Amendment 3

The Council implemented Amendment 3 to the Reef Fish FMP in 2005 to address required provisions of the Magnuson-Stevens Act (Caribbean SFA Amendment; CFMC 2005). The Council implemented the following measures:

- Established new FMUs for reef fish;
- Required that fish traps have an 8 inch by 8 inch panel (with mesh not smaller than the mesh of the trap) on one side of the trap (excluding top, bottom and the side of the door) attached with untreated jute twine (diameter less than 1/8 inch);
- Required that individual traps or pots have at least one buoy attached that floats on the surface.
- Required that traps or pots tied together in a trap line have at least one buoy that floats at the surface at each end of the trap line.
- Prohibited the use of gillnets and trammel nets in the EEZ.
- Established a seasonal closure in the area known as Grammanik Bank south of St. Thomas, USVI.
- Prohibited the use of bottom tending gear (traps, pots, gillnets, trammel nets, bottom longlines) in the seasonally closed areas including Grammanik Bank.
- Required an anchor retrieval system for anyone fishing or possessing Caribbean reef fish species.
- Prohibited the filleting of fish at sea.
- Established seasonal closures (no fishing or possession), every year during the specified months, for Snapper Unit 1 (silk, black, blackfin and vermillion snappers) from October 1 through December 31, Grouper Unit 4 (tiger, yellowfin, yellowedge, red and black) from February 1 through April 30, red hind from December 1 through the last day of February, and lane and mutton snappers from April 1 through June 30.
- Established MSY, OY, minimum stock size threshold, and maximum fishing mortality threshold for each FMU.

Amendment 4

The Council published a NOI in the *Federal Register* on October 9, 2007 (72 FR 57307) to prepare a DEIS for Amendment 4 to the Reef Fish FMP. The proposed alternatives would consider measures to implement escape vents in the trap fishery sector. However, the Council postponed Amendment 4 until a pilot study could be conducted to determine the effective size of escape vents.

Regulatory Amendment 3

The Council implemented Regulatory Amendment 3 to the Reef Fish FMP (CFMC 2010; 50 CFR Part 622) in December 2010. The amendment modified the Bajo de Sico seasonal closure. Bajo de Sico has been identified as an important spawning site, especially for red hind and possibly other resident groupers including Nassau and yellowfin, as well as an important foraging site for these and other Caribbean reef fish. Bajo de Sico has been described as a well-developed and diverse coral and sponge habitat that provides essential fish habitat for Caribbean reef fish. The purpose of the regulatory amendment was to protect red hind spawning aggregations and large snappers and groupers from directed fishing mortality. Primary management measures implemented through this amendment include:

- Extended the original length of the yearly seasonal closure for Bajo de Sico from December 1 through the last day of February to October 1 through March 31;
- Prohibited fishing for or possession of Council-managed reef fish species in Bajo de Sico;
- Prohibited anchoring year-round within Bajo de Sico. Fishing for HMS, coastal migratory pelagics (dolphin, wahoo, jacks, and mackerel) and spiny lobster would be allowed all year.

Amendment 5

The Council implemented Amendment 5 to the Reef Fish FMP (CFMC 2011a; 76 FR 82404) in January 2012 to address the new requirements of the 2007 reauthorization of the Magnuson-Stevens Act. The primary management measures implemented by this amendment were:

- Amended the stock complexes in the Reef Fish FMUs:
  - Separated Grouper Unit 4 into Grouper Unit 4 (yellowfin, red, tiger, plus black groupers) and Grouper Unit 5 (yellowedge and misty groupers).
  - Removed creole fish from Grouper Unit 3.
  - Modified the snapper FMU by adding cardinal snapper to Snapper Unit 2 and moving wenchman to Snapper Unit 1.
- Prohibited harvest of three parrotfish species (midnight, blue, and rainbow).
- Specified ACLs and AMs to prevent overfishing of these snappers, groupers, and parrotfish.
- Established Reference Points: MSY and OY.
- Established framework measures to facilitate regulatory modifications.

- Adjusted management measures as needed to constrain harvest to specified ACLs.
- Established recreational bag limits for snappers, groupers, and parrotfish.
- Subdivided the U.S. Caribbean EEZ for purposes of tracking catch and applying AMs.

Amendment 6

The Council implemented Amendment 6 to the Reef Fish FMP (CFMC 2011b; 76 FR 82414) in January 2012. The primary management measures implemented through this amendment are as follows:

- Revised management reference points for species not identified as undergoing overfishing within the Reef Fish FMP.
- Redefined the Aquarium Trade Species FMUs within the Reef Fish FMP and the Coral FMP.
- Established recreational bag limits for managed reef fish species not designated as undergoing overfishing.

Regulatory Amendment 4

The Council completed Regulatory Amendment 4 in August 2013 (CFMC 2013; 78 FR 45894) to establish a commercial and recreational minimum size limit for parrotfish harvest in the U.S. Caribbean EEZ off St. Croix. A minimum size limit would allow juveniles to mature into reproductively active individuals and have a chance to spawn prior to harvest. The Council chose an 8-in fork length (FL) for redband parrotfish and a 9 inches FL for all other parrotfish species. The Council chose a smaller FL for redband because it is a relatively smaller fish and the fish would reach sexual maturity at a smaller size than the other allowable parrotfish species.

1.5.3 Highly Migratory Species

This section provides a brief overview and history of Atlantic HMS management.

Atlantic HMS are managed under the dual authority of the Magnuson-Stevens Act and the Atlantic Tunas Convention Act (ATCA). Under the Magnuson-Stevens Act, NMFS must, consistent with ten National Standards, manage fisheries to maintain OY by rebuilding overfished fisheries and preventing overfishing. Under ATCA, NMFS is authorized to promulgate regulations, as may be necessary and appropriate to carry out binding recommendations of the International Commission for the Conservation of Atlantic Tunas (ICCAT). Additionally, any management measures must be consistent with other domestic laws including, but not limited to, the National Environmental Policy Act (NEPA), the Endangered Species Act, the Marine Mammal Protection Act, and the Coastal Zone Management Act.

In 1985, NMFS implemented a FMP for Atlantic Swordfish and, in 1988, a FMP for Atlantic Billfishes. On November 28, 1990, the President signed into law the Fishery Conservation Amendments of 1990 (Pub. L. 101-627). This law amended the Magnuson Fishery Conservation and Management Act (later renamed the Magnuson-Stevens Fishery Conservation and Management Act or Magnuson-Stevens Act) and gave the Secretary the authority to manage HMS in the EEZ of the Atlantic Ocean, Gulf of Mexico, and Caribbean Sea under authority of the Magnuson-Stevens Act (16 U.S.C. § 1811). This law also transferred from the Fishery Management Councils to the Secretary management authority for HMS in the Atlantic Ocean, Gulf of Mexico, and Caribbean Sea (16 U.S.C. §1854(f)(3)). At that time, the Secretary delegated authority to manage Atlantic HMS to NMFS. In 1993, NMFS implemented an FMP for Sharks of the Atlantic and, in 1999, Amendment 1 to the Atlantic Billfish FMP.

In 1999, NMFS finalized the 1999 FMP for Atlantic Tunas, Swordfish, and Sharks (NMFS1999). The 1999 FMP was then amended in 2003 (NMFS 2003). NMFS then consolidated the Atlantic Tunas, Swordfish, and Sharks FMP and its amendments and the Atlantic Billfish FMP and its amendments into the 2006 Consolidated Atlantic HMS FMP (NMFS 2006). The Consolidated Atlantic HMS FMP was amended in 2008 (NMFS 2008), 2009, 2010, 2012, and 2013.

In managing Atlantic HMS through FMPs and implementing regulations, NMFS must comply with all applicable provisions of the Magnuson-Stevens Act (16 U.S.C. § 1852(a)(3)). The HMS regulations are located in Code of Federal Regulations (CFR) at 50 CFR Part 635. NMFS must maintain optimal yield of each fishery while preventing overfishing (16 U.S.C. § 1851(a)(1)).

When a fishery is determined to be in or approaching an overfished condition, NMFS must include in the FMP conservation and management measures to prevent or end overfishing and rebuild the fishery, stock or species (16 U.S.C. §§ 1853(a)(10); 1854(e)). NMFS must consider the National Standards in developing FMPs, including requirements to use the best scientific information as well as the potential impacts on residents of different States, efficiency, costs, fishing communities, bycatch, and safety at sea (16 U.S.C. § 1851 (a)(1-10)).

The Magnuson-Stevens Act also has a specific section that addresses preparing and implementing FMPs for Atlantic HMS (16 U.S.C. §1854 (g)(1)(A-G)). This section of the Magnuson-Stevens Act includes, but is not limited to, requirements to:

- Consult with and consider the views of affected Councils, Commissions, and advisory groups.
- Evaluate the likely effects of conservation and management measures on fishery participants and minimize, to the extent practicable, any disadvantage to U.S. fishermen in relation to foreign competitors;
- Provide fishing vessels with a reasonable opportunity to harvest any allocation or quota authorized under an international fishery agreement;
- Diligently pursue, through international entities, such as the ICCAT, comparable international fishery management measures; and,
- Ensure that conservation and management measures promote international conservation of the affected fishery, take into consideration traditional fishing patterns of fishing vessels, are fair and equitable in allocating fishing privileges among U.S. fishermen and do not have economic allocation as the sole purpose, and promote, to the extent practicable, implementation of scientific research programs that include the tagging and release of Atlantic HMS.

The 2006 Consolidated Atlantic HMS FMP contains a broad range of management objectives including (but not limited to) preventing overfishing of Atlantic HMS; rebuilding overfished Atlantic HMS stocks; monitoring and controlling all components of fishing mortality so as to ensure long-term sustainability of the stocks and promote Atlantic-wide stock recovery; minimizing bycatch; managing for continuing OY so as to provide the greatest overall benefit to the Nation; minimizing, to the extent practicable, adverse social and economic impacts; providing a framework to take necessary action under ICCAT recommendations; and simplifying HMS management and regulatory requirements to assist the regulated community.

Chapter 2. Proposed Actions

2.1 Action 1: Modify the Length of the Closed Fishing Season

Alternative 1: No Action: Retain the existing length of the closed season in each of the Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank managed areas.

Alternative 2: Modify the Bajo de Sico closed season to be December 1-last day of February.

Alternative 3: Modify the closed season to be October 1-March 31 **(Preferred).**
Sub-Alternative a: Abrir La Sierra Bank **(Preferred)**
Sub-Alternative b: Tourmaline Bank **(Preferred)**

Alternative 4: Modify the closed season to be December 1-May 31.
Sub-Alternative a: Abrir La Sierra Bank
Sub-Alternative b: Bajo de Sico
Sub-Alternative c: Tourmaline Bank

Alternative 5: Modify the closed season to be year-round.
Sub-Alternative a: Abrir La Sierra Bank
Sub-Alternative b: Bajo de Sico
Sub-Alternative c: Tourmaline Bank

Discussion: **Alternative 1** would maintain the status quo. Abrir La Sierra Bank and Tourmaline Bank would remain closed to fishing activities defined in Actions 2, 3, 5, and 6 from December 1 to the last day of February, each year. Bajo de Sico would remain closed to specified fishing activities from October 1 to March 31, each year. Additionally, the previously established year-round restrictions on bottom-tending gear (pots, traps, bottom longlines, gillnets, and trammel nets) will remain in place. In addition to these closures, fishing for and possession of red, black, tiger, yellowfin, and yellowedge groupers from February 1 through April 30 for the entire exclusive economic zone (EEZ), which includes portions of Bajo de Sico and Tourmaline Bank as well as the entirety of Abrir La Sierra Bank (Figure 1.3.1). There is also a closure of the EEZ to harvest of vermilion, black, silk, and blackfin snappers during October 1 through December 31. Red hind harvest in or from the Caribbean EEZ west of 67°10' W. longitude is also prohibited from December 1 through the last day of February, each year. There is an additional closure from

April 1 to June 30 for lane and mutton snappers in the EEZ (Table 2.1). These management measures combined result in closures for one or more snapper and grouper species within the entire EEZ (including the managed areas) running from October 1 through June 30. Since there is a high probability of catching prohibited species incidentally when targeting other reef fish species, fishers may tend to avoid areas where such species comingle, such as Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. Consequently, under current species-specific closures, Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank may not be ideal places to target allowable species because of the high probability of catching prohibited species, thus increasing mortality on species needing protection and trip-related costs (i.e. fuel, bait, time), and potentially risking prosecution for possession of prohibited species.

When fishing activities are allowed, important coral habitat may be threatened by anchoring vessels and possible gear interactions. García-Sais et al. (2007) describes incidents of monofilament fishing line wrapped around corals, indicating unintended but adverse fishermen-coral interactions. Among the gears still allowed in the three areas are vertical longlines, bandit type gear, hook and line, spearfishing, and harvest by hand. By prohibiting certain fishing activities, coral populations are better protected from such gear interactions and entanglements.

Table 2.1 Species-Specific Closures in the U.S. Caribbean EEZ and Proposed Seasonal Closures

Current Species Closures	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Red Hind (west of 67°10' W only)	X	X										X
Vermilion, black, silk, or blackfin snappers										X	X	X
Red, black, tiger, yellowfin, and yellowedge grouper		X	X	X								
Lane and mutton snapper				X	X	X						
Proposed Seasonal Closure												
Proposed Alternative 1 (Current Seasonal Closures)	A, B, T	A, B, T	B							B	B	A, B, T
Proposed Alternative 2	B	B										B
Proposed Alternative 3a **(Preferred)**	A	A	A							A	A	A
Proposed Alternative 3b **(Preferred)**	T	T	T							T	T	T
Proposed Alternative 4a	A	A	A	A	A							A
Proposed Alternative 4b	B	B	B	B	B							B
Proposed Alternative 4c	T	T	T	T	T							T
Proposed Alternative 5a	A	A	A	A	A	A	A	A	A	A	A	A
Proposed Alternative 5b	B	B	B	B	B	B	B	B	B	B	B	B
Proposed Alternative 5c	T	T	T	T	T	T	T	T	T	T	T	T

"X": Harvest Prohibited
"A": Abrir La Sierra Bank Seasonal Closure
"B": Bajo de Sico Seasonal Closure
"T": Tourmaline Bank Seasonal Closure

Alternative 2 would decrease the seasonal closure of Bajo de Sico from the present October 1 through March 31 closure to a December 1 through the last day of February closure, each year. **Alternative 2** would result in the three areas having the same lengths and dates of seasonal closures. Additionally, a three-month closure may result in increased fishing pressure in Bajo de Sico relative to the present closure because of the longer fishing season.

Preferred Alternative 3 would increase the length of the seasonal closure for Abrir La Sierra Bank and/or Toumaline Bank to six months (October 1 through March 31), each year. The Caribbean Fishery Management Council (Council) has the option to select this alternative for Abrir La Sierra Bank only, Tourmaline Bank only, or for both areas. If the Council chooses **Preferred Alternative 3** for both areas, but chose no other preferred alternatives within this Action, Bajo de Sico regulations would remain the same and consistent closed seasons would be established for all three areas. However, if the Council chooses this alternative for one area and not the other, then inconsistent seasonal closures among the three areas would remain. For instance, if the Council selects only **Preferred Sub-Alternative 3a**, Bajo de Sico and Abrir La Sierra Bank would have consistent regulations but the Tourmaline Bank closure period would differ. This would not facilitate enforcement or avoid confusion among constituents and would therefore not achieve the stated purpose of the Action.

In addition to spanning the time frame of the original seasonal closure for Abrir La Sierra Bank and/or Tourmaline Bank (i.e., December through the end of February), **Preferred Alternative 3** would span the seasonal closure for vermilion, black, silk, and blackfin snappers, which occurs from October 1 through December 31. Additionally, there is a closure from December 1 through the end of February which prohibits the harvest of red hind from the Caribbean EEZ west of 67°10' W longitude, which includes Bajo de Sico, Abrir La Sierra Bank, and Tourmaline Bank (Figure 1.3.1). Finally, harvest of red, black, tiger, yellowfin, and yellowedge groupers is prohibited from February 1 through April 30. **Preferred Alternative 3** would cover most but not all of this closure period. All of these species occur in surrounding waters year-round and are part of the commercial and recreational catch (Erdman 1976; Boardman and Weiler 1979; Kimmel 1985). Also, **Preferred Alternative 3** expands the protection to all reef fish, including the species with seasonal closures described above, species for which no closed seasons are established, and species with closures in areas outside of the subject areas.

Alternative 4 would establish a modified closure from December 1 through May 31. In addition to the present seasonal closure of Abrir La Sierra Bank and Tourmaline Bank (i.e., December through the end of February), the **Alternative 4** closure would overlap with seasonal closures already established in federal waters for various snapper and grouper species (Table 2.1). Fishing for and possession of red, black, tiger, yellowfin, and yellowedge groupers are prohibited during February 1 through April 30, and during April 1 through June 30 for lane and mutton snappers, and during December 1 through the last day of February for red hind in the Caribbean EEZ west of 67°10' W longitude.

Alternative 5 would establish a year-round closure thereby providing the greatest protection to all species. Under **Alternative 5**, fishers would be prohibited from fishing activities specified in Actions 2, 3, 5, and 6. Similar to **Alternative 4**, **Alternative 5** would be incompatible with Puerto Rico regulations (no seasonal closure), thus creating additional confusion among fishers and enforcement agents. With differing closure dates, it would be more difficult for constituents to distinguish which jurisdiction (state or federal) is closed or open and when.

Under either **Alternative 4** or **Alternative 5**, the Council has the option to select the alternative for one, two, or all three of the managed areas. Selecting **Sub-Alternatives a**, **b**, and **c** from within either **Alternative 4** or **Alternative 5** would result in consistent regulations among the three areas in federal waters. As described in Chapter 1, there is a need to establish consistent regulations within federal waters to alleviate confusion among fishers and enforcement agents. However, if the Council chooses a sub-alternative for one area and not the others, inconsistencies among the three areas would remain. For example, if the Council selects **Sub-Alternative 4a**, **4b,** and **Sub-Alternative 5c**, Bajo de Sico and Abrir La Sierra Bank would have consistent regulations while Tourmaline Bank would remain inconsistent. This would hinder enforcement and perpetuate confusion among constituents.

2.2 Action 2: Modify Reef Fish Fishing Activities

Alternative 1: No Action: Retain the existing reef fish harvest regulations in each of the Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank managed areas.

Alternative 2: Prohibit fishing for Council-managed reef fish in Bajo de Sico during the seasonal closure established in Action 1

Alternative 3: Prohibit fishing for and possession of Council-managed reef fish during the seasonal closure established in Action 1 **(Preferred)**
Sub-Alternative a: Abrir La Sierra Bank **(Preferred)**
Sub-Alternative b: Tourmaline Bank **(Preferred)**

Discussion: **Alternative 1** would maintain the status quo and therefore will not achieve the purpose of this action. The federal portions of Abrir La Sierra Bank and Tourmaline Bank would remain closed to all fishing activities, including reef fish, spiny lobster, coastal migratory pelagics (dolphin, wahoo, jacks, and mackerel), and highly migratory species (HMS), during the time specified in Action 1. Under **Alternative 1**, the federal portion of Bajo de Sico would remain closed to fishing for and possession of Council-managed reef fish, but fishing for and possession of spiny lobster, coastal migratory pelagics, and HMS would continue to be allowed. Additionally, the current year-round restrictions on bottom-tending gear (pots, traps, bottom longlines, gillnets, and trammel nets) would still apply. The closures were originally implemented in 1993 (Tourmaline Bank) and 1996 (Abrir La Sierra Bank and Bajo de Sico) to protect spawning populations of red hind. Since then, red hind stocks have increased in size and abundance but scientists have recently discovered spawning populations of snappers and other groupers. **Alternative 1** of Action 2 would maintain the present level of protection for the species comprising these spawner aggregations, dependent on the closure period chosen in Action 1.

Presently, there is a closure for red, black, tiger, yellowfin, and yellowedge groupers from February 1 through April 30 for the entire EEZ, which includes all of Abrir La Sierra Bank and portions of Bajo de Sico and Tourmaline Bank (Figure 1.3.1). There is also a closure of the EEZ to harvest of vermilion, black, silk, and blackfin snappers during October 1 through December 31. There is a third closure from April 1 to June 30 for lane and mutton snappers in the EEZ. Red hind harvest in or from the Caribbean EEZ west of 67°10' W. longitude is also prohibited from December 1 through the last day of February, each year. These management measures combined result in closures for one or more snapper and grouper species within the managed areas from October 1 through June 30. Since there is a high probability of incidentally catching species included in these seasonal closures when targeting other reef fish species, fishers may tend to avoid closed areas where such species comingle. Consequently, under current species-specific closures, the managed areas would not be an ideal place to target species that are allowed

because of the high probability of capturing a prohibited species, thus increasing mortality on species needing protection and risking prosecution for harvest or possession of prohibited species. Also, if the area is fished, there will be financial costs associated with the purchase of bait and fuel as well as opportunity costs associated with the time spent fishing to capture species that would have to be discarded due to regulatory requirements.

Alternative 2 would continue to prohibit fishers from fishing for Council-managed reef fish included under the Council's Reef Fish Fishery Management Plan (FMP; Appendix A) within the federal portion of Bajo de Sico for the duration of the closure established in Action 1[1]. Under current regulations, fishers also are prohibited from possessing Council-managed reef fish within federal portions of Bajo de Sico during the seasonal closure. However, **Alternative 2** would modify regulations to allow them to possess Council-managed reef fish in Bajo de Sico, which would allow vessels to travel through the area with reef fish harvested at other locations where fishing for reef fish is permitted. If the Council chooses **Alternative 2**, fishers could possess Council-managed reef fish in Bajo de Sico, Tourmaline Bank, and Abrir La Sierra Bank when those areas are closed to reef fish harvest. If the Council selects **Alternative 2**, all three areas would have consistent regulations. **Alternative 2** could reduce trip-related costs by allowing vessels to take shorter and less dangerous routes from open fishing grounds.

Preferred Alternative 3 would continue the prohibition on harvest of all Council-managed reef fish within both Abrir La Sierra Bank and Tourmaline Bank. In addition, it would no longer allow possession of Council-managed reef fish in one or both areas. Under this alternative, fishers would no longer be able to transit through the specified area(s) while they have Council-managed reef fish onboard, even if those fish were harvested from other areas. The Council has the option to select this alternative for either Abrir La Sierra Bank, Tourmaline Bank, or both areas. If the Council chooses **Preferred Alternative 3** for both areas, there would be consistent prohibitions on possession of Council-managed reef fish between all three areas (Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank). However, if the Council chooses **Preferred Alternative 3** for one area and not the other, then inconsistencies between the three areas would remain. For instance, if the Council selects only **Preferred Sub-Alternative 3a**, Bajo de Sico and Abrir La Sierra Bank would prohibit possession but not Tourmaline Bank. Taken together, **Preferred Sub-Alternatives 3a** and **3b** would result in consistent possession prohibitions in the three managed areas in federal waters.

Under each of the alternatives, including **Preferred Alternative 3**, the current year-round restrictions on bottom-tending gear (pots, traps, bottom longlines, gillnets, and trammel nets) would still apply. Fishers would still not be able to use such bottom-tending gear. This prohibition would provide additional protection to the important benthic habitat.

[1] Regulations define fishing as, "*Fishing*, or *to fish* means any activity, other than scientific research conducted by a scientific research vessel, that involves: (1) The catching, taking, or harvesting of fish; (2) The attempted catching, taking, or harvesting of fish; (3) Any other activity that can reasonably be expected to result in the catching, taking, or harvesting of fish; or (4) Any operations at sea in support of, or in preparation for, any activity described in paragraphs (1), (2), or (3) of this definition." (50 CFR § 600.10) However, a vessel that has gear on board, which is properly stowed, would not be considered to be fishing.

2.3 Action 3: Modify Spiny Lobster Fishing Activities

Alternative 1: No Action: Retain the existing spiny lobster regulations in each of the Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank managed areas.

Alternative 2: Prohibit fishing for spiny lobster in Bajo de Sico during the seasonal closure established in Action 1

Alternative 3: Prohibit fishing for and possession of spiny lobster during the seasonal closure established in Action 1

Sub-Alternative a: Abrir La Sierra Bank
Sub-Alternative b: Bajo de Sico
Sub-Alternative c: Tourmaline Bank

Alternative 4: Prohibit fishing for spiny lobster year-round

Sub-Alternative a: Abrir La Sierra Bank
Sub-Alternative b: Bajo de Sico
Sub-Alternative c: Tourmaline Bank

Alternative 5: Prohibit fishing for and possession of spiny lobster year-round

Sub-Alternative a: Abrir La Sierra Bank
Sub-Alternative b: Bajo de Sico
Sub-Alternative c: Tourmaline Bank

Alternative 6: Allow fishing for spiny lobster year-round **(Preferred)**

Sub- Alternative a: Abrir La Sierra Bank **(Preferred)**
Sub- Alternative b: Bajo de Sico **(Preferred)**
Sub- Alternative c: Tourmaline Bank **(Preferred)**

Discussion: **Alternative 1** would maintain the status quo and therefore will not achieve the purpose of this action. The federal portions of Abrir La Sierra Bank and Tourmaline Bank would remain closed to all fishing activities, including reef fish, spiny lobster, coastal migratory pelagics, and HMS, during the time specified in Action 1. Under **Alternative 1**, the federal portion of Bajo de Sico would remain open to fishing for spiny lobster. Additionally, the current year-round bottom-tending gear restrictions (pots, traps, bottom longlines, gillnets, and trammel nets) would still apply.

Alternative 2 would prohibit fishers from fishing for spiny lobster within the federal portion of Bajo de Sico for the duration of the closure established in Action 1. Currently, fishers are allowed to fish for spiny lobster in Bajo de Sico throughout the year. If the Council selects **Alternative 2** with no other preferred alternatives, the prohibition on fishing for spiny lobster in Bajo de Sico would be consistent with Abrir La Sierra Bank and Tourmaline Bank.

Alternative 3 would prohibit the harvest and possession of spiny lobster within one, two, or all three managed areas during their respective seasonal closures. Under this alternative, fishers would no longer be allowed to transit through the specified area while they have spiny lobster onboard, even if those spiny lobster were harvested from other areas. **Alternative 3** could increase trip-related costs by requiring vessels to take longer routes from open spiny lobster fishing grounds.

Alternative 4 would prohibit harvest, but allow possession, of spiny lobster throughout the year in one, two, or all three of the managed areas dependent on the sub-alternative(s) chosen. Under **Alternative 4**, fishers may transit through the area as long as the lobsters were harvested outside the area.

Alternative 5 would prohibit the fishing for and possession of spiny lobster all year in the area(s) chosen by the Council. Under this alternative, fishers would be prohibited from transiting through the specified area while they have spiny lobster onboard, even if those spiny lobster were harvested from other areas.

Preferred Alternative 6 would allow fishing for spiny lobster all year within the federal portions of one, two, or all three of the managed areas. Under this alternative, fishers would be able to harvest spiny lobster throughout the year from Abrir La Sierra Bank, Bajo de Sico, and/or Tourmaline Bank, depending on the sub-alternative(s) chosen by the Council.

Under each of the alternatives, including **Preferred Alternative 6**, the current year-round restrictions on bottom-tending gear (pots, traps, bottom longlines, gillnets, and trammel nets) would still apply. Fishers would still not be able to use such bottom-tending gear. This prohibition would provide additional protection to the important benthic habitat.

Under **Alternatives 3-6**, the Council has the option to select the alternative for one, two, or all three of the managed areas. Selecting **Sub-Alternatives a**, **b**, and **c** would result in consistent regulations among the three areas in federal waters. As described in Chapter 1, there is a need to establish consistent regulations within federal waters to alleviate confusion among fishers and enforcement agents. However, if the Council chooses an alternative for one area and not the others, inconsistencies between the three areas would remain. For example, if the Council selects **Sub-Alternative 4a**, **4b,** and **Sub-Alternative 3c**, Bajo de Sico and Abrir La Sierra Bank would have consistent regulations while Tourmaline Bank regulations would be inconsistent with those two. This would not facilitate enforcement or avoid confusion among constituents.

2.4 Action 4: Prohibit Anchoring

Alternative 1: No Action. Retain the existing anchoring prohibitions in each of the Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank managed areas.

Alternative 2: Prohibit anchoring during the seasonal closure established in Action 1

Sub-Alternative a: Abrir La Sierra Bank

Sub-Alternative b: Bajo de Sico

Sub-Alternative c: Tourmaline Bank

Alternative 3: Prohibit anchoring year-round **(Preferred)**

Sub-Alternative a: Abrir La Sierra Bank **(Preferred)**

Sub-Alternative b: Tourmaline Bank **(Preferred)**

Discussion: Scientists agree that anchoring causes substantial and long lasting damage to coral populations (Tratalos and Austin 2001). Not only is setting anchors harmful to coral populations, but retrieval of the anchors and the movement of the anchor or anchor chain while on the ocean floor can cause damage as well (Dinsdale and Harriott 2004). Each time a vessel drops their anchor onto a coral reef, or an anchor strikes against corals, there is a risk of coral fracture, abrasion to surface tissue and carbonate skeletons, removal of colonies from the substratum, or even death of the coral colony (Dinsdale and Harriott 2004).

Anchoring can also indirectly impact the long-term growth of coral populations. As corals are damaged, they must divert energy from growth to repair (Dinsdale and Harriott 2004). If coral populations, an essential part of the ecology of reef environments, decrease, fish populations could be indirectly impacted by lack of available habitat. Data indicate that reefs damaged by anchoring activities may take more than 50 years to recover, if they are ever able to do so (Allen 1992).

In December 2010, the Council implemented regulations to prohibit anchoring year-round in Bajo de Sico. Anchoring is also prohibited year-round in the Puerto Rico portion of Bajo de Sico. However, there are currently no restrictions on anchoring within Abrir La Sierra Bank or the federal portion of Tourmaline Bank. Anchoring within the Puerto Rico portion of Tourmaline Bank is prohibited year-round. Without additional regulations, no change in the biological environments would be expected, therefore the coral reef populations would continue to be vulnerable to damage caused by anchors.

Alternative 1 would maintain the status quo and therefore will not achieve the purpose of this action. Under **Alternative 1**, anchoring by fishing vessels would continue to be allowed in Abrir La Sierra Bank

and Tourmaline Bank and continue to be prohibited in Bajo de Sico year-round. Maintaining the current regulations would not benefit the physical environments of Abrir La Sierra Bank or Tourmaline Bank, and may in fact lead to declines of coral cover and associated biological communities if important reef processes are interrupted due to interactions with anchors, as previously discussed. The coral reef's ability to survive and replenish degraded habitat may be compromised by interruptions in these processes. Without healthy coral populations, reef ecosystems may begin to decline, affecting important habitat areas and the associated biological and ecological environments by reducing biodiversity and further limiting habitat. In addition, maintaining the current regulations would also prevent consistent regulations among the three areas because anchoring within Bajo de Sico is currently prohibited but such prohibitions do not exist inside the federal portions of Abrir La Sierra Bank and Tourmaline Bank. **Alternative 1** would be incompatible with Puerto Rico's year-round prohibition on anchoring within the three managed areas.

Alternative 2 would prohibit anchoring by fishing vessels, during the seasonal closure established in Action 1, in one, two, or all three areas, as chosen by the Council. **Sub-Alternatives 2a** and **2c** would provide increased protection to the benthic habitat relative to **Alternative 1** because vessels would only be able to anchor part of the year, but it would provide less protection than would **Preferred Alternative 3**, which prohibits anchoring year-round. However, **Sub-Alternative 2b** would provide decreased protection to benthic habitats in Bajo de Sico because anchoring is currently prohibited year-round and **Sub-Alternative 2b** would result in opening part of the year to anchoring within Bajo de Sico. Under **Alternative 2**, federal portions of the managed areas would be compatible with Puerto Rico for only part of the year, leaving confusion for fishers about when they can anchor in what area.

Preferred Alternative 3 would prohibit anchoring all year in either or both of Abrir La Sierra Bank (**Preferred Sub-Alternative 3a)** or Tourmaline Bank (**Preferred Sub-Alternative 3b)**. Under this alternative, fishing vessels would be prohibited from anchoring in either or both of those managed areas depending on the sub-alternative chosen. If both sub-alternatives are chosen, all three managed areas would be closed to anchoring year-round, thus providing consistent anchoring regulations and alleviating any confusion among consistuents. Year-round anchoring prohibitions would also provide year-round benefits to the corals and other benthic habitat found within the areas as well as result in compatible regulations with Puerto Rico.

Under **Alternative 2** and **Preferred Alternative 3**, the Council has the option to select the sub-alternative for one or multiple areas. Selecting **Sub-Alternatives 2a**, **2b**, and **2c** or **Preferred Sub-Alternatives 3a** and **3b** would result in consistent anchoring regulations among the three managed areas in federal waters. However, if the Council chooses a different combination of alternatives, inconsistencies among the three areas would remain with respect to anchoring regulations. For instance, if the Council selects **Preferred Sub-Alternative 3a**, **3b,** and **Sub-Alternative 2b**, Tourmaline Bank and Abrir La Sierra Bank would have consistent regulations but Bajo de Sico would not be consistent with those two. This would not facilitate enforcement or avoid confusion among constituents, and would not provide complete protection to benthic habitats.

Under each of the alternatives, including **Preferred Alternative 3**, the current year-round restrictions on bottom-tending gear (pots, traps, bottom longlines, gillnets, and trammel nets) would still apply. Fishers would still not be able to use such bottom-tending gear. This prohibition would provide additional protection to the important benthic habitat.

2.5 Action 5: Modify Highly Migratory Species Fishing Activities

Alternative 1: No Action- Retain the current HMS fishing regulations in each of the Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank managed areas.

Alternative 2: Upon request of the Council, prohibit bottom longline fishing for HMS year-round in Bajo de Sico **(Preferred)**

Alternative 3: Upon request of the Council, prohibit fishing for HMS in some or all of the three areas during the seasonal closure established in Action 1

Sub-Alternative a: Abrir La Sierra Bank

Sub-Alternative b: Bajo de Sico

Sub-Alternative c: Tourmaline Bank

Alternative 4: Upon request of the Council, prohibit fishing for HMS in some or all of the three areas during the seasonal closure established in Action 1, with an exception that would allow only surface trolling, as defined at §635.21(a)(4)(iv), for all HMS **(Preferred)**

Sub-Alternative a: Abrir La Sierra Bank **(Preferred)**

Sub-Alternative b: Bajo de Sico **(Preferred)**

Sub-Alternative c: Tourmaline Bank **(Preferred)**

Alternative 5: Upon request of the Council, allow fishing for bigeye, albacore, yellowfin and skipjack (BAYS) tunas with speargun fishing gear in some or all of the three areas during the seasonal closure established in Action 1.

Sub-Alternative a: Abrir La Sierra Bank

Sub-Alternative b: Bajo de Sico

Sub-Alternative c: Tourmaline Bank

Discussion: Proposed Action 5 would apply only to fishing activities for Atlantic HMS, including swordfish, billfish (blue marlin, white marlin, sailfish, and roundscale spearfish), tunas (bluefin, bigeye, albacore, yellowfin, and skipjack), and most species of sharks. Since 1992, these species have been managed under the authority of the U.S. Secretary of Commerce (16 U.S.C. § 1811). The Council is considering actions to establish consistent regulations among three areas: Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. Therefore, to improve the effectiveness and enforcement of the fishery

management measures for reef fish adopted by the Council for these three areas, it could be beneficial for the Council to request that NOAA's National Marine Fisheries Service (NMFS) implement compatible management measures for HMS fishing activities that could be adopted simultaneously. The purpose of proposed Action 5 is to describe current HMS fishery management measures that are specifically applicable to these three areas, and identify potential alternatives which could help accomplish the goals and objectives of this amendment.

Alternative 1 is the no action alternative and would retain the current fishery management regulations for Atlantic HMS in the Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank areas. The current regulations for Council-managed species at 50 CFR §622 prohibit all bottom-tending gear (pots, traps, bottom longlines, gillnets or trammel nets) throughout the year in the three areas. However, under current HMS regulations, found at 50 CFR §635, bottom longline gear is prohibited throughout the year only in Abrir La Sierra Bank and Tourmaline Bank, but not in Bajo de Sico. While there are other recreational and commercial federal HMS fishery management measures that apply in the U.S. Caribbean, there are no other HMS management measures exclusively specific to these three areas. Thus, although the Council has also prohibited all "fishing" during the closed seasons for Abrir La Sierra Bank and Tourmaline Bank, there are not compatible regulations in the HMS regulations at 50 CFR §635 to prohibit fishing for HMS during the closed seasons. The overall effect of this alternative would be neutral because it would retain existing HMS regulations. However, **Alternative 1** would likely not achieve compatibility with the Council regulations and, therefore, would not achieve the purpose of this amendment which is, in part, to establish consistent regulations between the three areas. Depending upon the measures selected by the Council, enforcement within these areas could continue to be affected because it would remain difficult to determine if vessels are fishing for HMS or for reef species. Similarly, potential detrimental impacts to important benthic habitat could continue to occur in Bajo de Sico due to the continued allowance of bottom longline gear to fish for HMS. Both of these impacts could affect stock rebuilding efforts for Council-managed reef fish. There would be no change in impacts to HMS or HMS fisheries, as this alternative would maintain current HMS regulations in these three areas.

Preferred Alternative 2 would, upon request of the Council, prohibit HMS bottom longline gear throughout the year in Bajo de Sico. The current regulations for Council-managed species at 50 CFR §622 prohibit all bottom-tending gear (pots, traps, bottom longlines, gillnets or trammel nets) all year in the three areas. However, under current HMS regulations, found at 50 CFR §635, bottom longline gear is prohibited year-round to fish for HMS only in Abrir La Sierra Bank and Tourmaline Bank, but not in the Bajo de Sico area. Thus, **Preferred Alternative 2** could help to achieve compatibility with current Council regulations for Council-managed species, and would be consistent with HMS regulations prohibiting bottom longline gear in the Abrir La Sierra Bank and Tourmaline Bank areas. This action could help to achieve the purpose of this amendment which is, in part, to establish consistent regulations between the federal portions three areas. Enforcement within these areas could be improved because all bottom-tending gear would be prohibited year-round, with no exception for HMS bottom longline gear in Bajo de Sico. Similarly, potential detrimental impacts to important benthic habitat from the use of this

gear would not continue to occur in Bajo de Sico. Not having these detrimental impacts could improve stock rebuilding efforts for Council-managed reef fish. There could also be some beneficial impacts to HMS stock rebuilding, particularly sharks, however these are expected to be minimal because there have been no bottom longline sets in Bajo de Sico reported in HMS logbooks for the last ten years (2003 – 2012).

Alternative 3 would, upon request of the Council, prohibit all fishing for, and possession of, HMS in some or all of the three areas during the time period established in Action 1. Under current HMS regulations, fishing for HMS is allowed year-round in all three areas except that bottom longline gear is prohibited year-round in the Abrir La Sierra Bank and Tourmaline Bank areas. The impacts of this alternative depend largely upon the decisions of the Council in Action 2 (modify reef fish fishing activities). Currently, in the Council regulations at 50 CFR §622, all "fishing" is prohibited during the closed seasons in Abrir La Sierra Bank and Tourmaline Bank, but in Bajo de Sico only fishing for and possession of Council-managed reef species is prohibited during the closed season. The HMS sub-alternatives in **Alternative 3** may be selected in any combination to achieve compatible regulations between HMS and Council regulations for the three areas. Non-compatible regulations could continue to affect enforcement within the areas because it would remain difficult to determine if vessels are fishing for HMS or for other species. If the Council prohibits all fishing in some or all of the areas, and fishing for HMS is also prohibited in the same areas, then enforcement could be improved because all fishing would be prohibited in the same areas during the closed seasons. For HMS recreational fisheries, and some commercial HMS fisheries, this alternative could produce the greatest socio-economic impacts, as explained below. In October 2013, there were 604 HMS Angling permits and 18 HMS Charter/Headboat permits issued to vessels in Puerto Rico. Among commercial HMS permit holders, there were 83 Atlantic Tunas General Category as of October 2013, and in February 2014 there were 8 Swordfish General Commercial, and 2 Commercial Caribbean Small Boat permits issued in Puerto Rico. There are no HMS commercial permits issued in Puerto Rico that allow for the deployment of longline gear (i.e., shark, swordfish, and tuna limited access permits); however, vessels that are permitted in the U.S. pelagic longline fishery targeting HMS do offload to fish dealers in Puerto Rico. No HMS longline sets have been reported for the past ten years in the three areas. In summary, all HMS recreational and commercial permit holders that fish off the west coast of Puerto Rico could potentially be impacted by a seasonal prohibition on fishing for HMS in some or all of the three areas. Because of the highly migratory nature of tunas, swordfish, billfish, and sharks, any negative impacts to fishermen are expected to be minor because the areas are relatively small in size and other areas outside the managed areas will continue to be open for HMS fishing. Fishing areas outside the seasonally closed areas may or may not have different catch rates for HMS than inside the seasonally closed areas. Ecological impacts under **Alternative 3** could be positive to a minor extent. Spawning aggregations of reef fish and important benthic habitat would be protected. This could improve stock rebuilding efforts for Council-managed reef fish. There could also be some beneficial impacts to HMS stock rebuilding, particularly for sharks that inhabit benthic habitats.

Preferred Alternative 4 would, upon request of the Council, prohibit all fishing for HMS in some or all of the three areas during the time period established in Action 1 with an exception that would allow only surface trolling, as defined at §635.21(a)(4)(iv), for all HMS. Similar to **Alternative 3**, the impacts of **Alternative 4** depend largely upon the actions chosen for Council-managed fishing activities. The HMS sub-alternatives in **Alternative 4** can be selected to achieve compatible regulations between HMS and Council regulations for the three areas. Non-compatible regulations could continue to affect enforcement within the areas because it would remain difficult to determine if vessels are fishing for HMS or for other species. If the Council prohibits fishing in some or all of the areas only for Council-managed reef species, and only surface trolling is allowed for HMS in the same areas, then **Alternative 4** would establish compatible regulations between HMS and Council regulations. If the Council and HMS Management Division establish compatible regulations, then enforcement within the areas could be improved.

Fishing for several species of tuna and billfish can effectively occur using surface trolling techniques. The majority of HMS permits issued in Puerto Rico are HMS Angling (recreational), charter/headboat, or commercial handgear permits. Because these permits allow for surface trolling, socio-economic impacts under **Alternative 4** would remain largely unchanged for these participants. Fishing for HMS with pelagic longline and buoy gear would be prohibited in the selected areas during the seasonal closures, but there have been no reported sets by either gear sector in the areas for the past ten years. Thus, only minor socio-economic impacts are anticipated for pelagic longline and buoy gear users. Hook and line fishing for HMS that does not meet the definition for surface trolling would be prohibited during the three seasonal area closures. This could affect some current HMS fishing activities; however, due to the highly migratory nature of these species, the impacts are expected to be minor because the areas are relatively small in size. Non-surface trolling HMS fishing activities could likely occur just outside the areas during the closed seasons without a significant reduction in catch per unit effort. Ecological impacts under **Alternative 4** could be positive to a minor extent. Surface trolling gear has minimal impacts on important benthic habitat and, thus, this habitat would be protected. Protecting this habitat could improve stock rebuilding efforts for Council-managed reef fish. There could also be some beneficial impacts to HMS stock rebuilding, particularly sharks, which are more likely to inhabit benthic areas.

Alternative 5 would, upon request of the Council, allow fishing for bigeye, albacore, yellowfin, and skipjack (BAYS) tunas with speargun fishing gear in some or all of the three areas during the time period established in Action 1. Similar to **Alternatives 3** and **4**, the impacts of **Alternative 5** depend largely upon the actions chosen for Council-managed fishing activities. The HMS sub-alternatives in **Alternative 5** can be selected to achieve compatible regulations between HMS and Council regulations for the three areas. Non-compatible regulations could continue to affect enforcement within the areas because it would remain difficult to determine if vessels are fishing for HMS or for other species. If the Council prohibits fishing in some or all of the areas only for Council-managed reef species (with an exception that allows spearfishing for pelagics), and spearfishing is allowed for HMS in the same areas, then **Alternative 5** would establish compatible regulations between HMS and Council regulations. If the

Council and HMS Management Division establish compatible regulations, then enforcement within the areas could be improved.

Under certain conditions, fishing for BAYS tunas can effectively occur using speargun fishing gear. Many of the HMS permits issued in Puerto Rico are HMS Angling (recreational) and charter/headboat permits. Because these permits allow spearfishing for BAYS tunas during the seasonal closures, socio-economic impacts under **Alternative 5** would remain largely unchanged for these participants. Ecological impacts under **Alternative 5** would be nuetral. There are currently no HMS regulations that prohibit speargun fishing during the three seasonal closures, so there would be no regulatory change by allowing the activity. Speargun fishing for BAYS tunas has minimal impacts on important benthic habitat and, thus, this habitat would be protected.

2.6 Action 6: Modify Spearfishing Activities

Alternative 1: No Action: Retain the existing spearfishing regulations in each of the Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank managed areas.

Alternative 2: Prohibit spearfishing for Council-managed reef fish during the seasonal closure established in Action 1

Sub-Alternative a: Abrir La Sierra Bank

Sub-Alternative b: Bajo de Sico

Sub-Alternative c: Tourmaline Bank

Alternative 3: Prohibit spearfishing for all non-HMS-managed species, including Council-managed reef fish and coastal migratory pelagics, during the seasonal closure established in Action 1 **(Preferred)**

Sub-Alternative a: Abrir La Sierra Bank **(Preferred)**

Sub-Alternative b: Bajo de Sico **(Preferred)**

Sub-Alternative c: Tourmaline Bank **(Preferred)**

Alternative 4: Prohibit spearfishing for all non-HMS-managed species, including Council-managed reef fish and coastal migratory pelagics, year-round

Sub-Alternative a: Abrir La Sierra Bank

Sub-Alternative b: Bajo de Sico

Sub-Alternative c: Tourmaline Bank

Discussion: Although spear is a selective gear, and there is a low probability of bycatch, spearfishing may have chronic negative indirect effects on the fish populations located within an area. Studies demonstrate that areas protected from spearfishing have higher abundance and larger sizes of certain individuals than those areas where spear is allowed (Lloret et al. 2008). Common practice among spear fishers is to target the largest individual of a prized species thus causing a potential decrease in the average size of that species (Sluka and Sullivan 1998). The desire for larger individuals is also evidenced by the number of documented record holders for large individuals harvested by spear (http://www.iusarecords.com/ and http://freedive.net/ibsrc/index.htm). By removing the larger fish, only smaller individuals are left to spawn, resulting in a decrease in size and age at sexual maturation, as well the average size of the population as a whole (Sluka and Sullivan 1998). Groupers, in particular, are especially vulnerable because many species are protogynous hermaphrodites, changing from females to males as they mature (Sluka and Sullivan 1998). If larger grouper are preferentially targeted, the sex ratio likely will be skewed toward smaller females resulting in reduced fertilization rate and a general reduction in spawning success.

Because the Bajo de Sico, Tourmaline Bank, and Abrir La Sierra Bank were originally designed to serve as spawner refuges, such effects on spawning success are contrary to the stated goals of these managed areas – to protect spawning aggregations.

Alternative 1 is the no action alternative and would maintain the current spearfishing regulations in the three managed areas. Under this alternative, fishers would continue to be allowed to use spear to harvest reef fish. The use of spear is currently allowed to fish for other non-Council managed species such as HMS and coastal migratory pelagics. However, Action 2 proposes to prohibit fishing for and possession of Council-managed reef fish. This alternative would be in direct conflict with Action 2, thus not resulting in any change to allowed or prohibited activities within the areas other than what is currently proposed under Action 2. Fishers would still be able to use spear to fish for HMS and coastal migratory pelagic species, but not Council-managed reef fish. **Alternative 1** would only result in additional confusion among fishers and enforcement agents, thus not accomplishing one of the purposes of this amendment, that being to facilitate enforcement.

Alternative 2 would prohibit the use of spear to fish for Council-managed reef fish during the seasonal closure established in Action 1. Fishers would continue to be able to harvest coastal migratory pelagics and HMS with spear. Because this alternative would ban spearfishing for Council-managed reef fish, spawning aggregations of reef fish would be provided additional protection from fishing mortality through this gear. However, because fishers would still be able to spearfish for HMS and coastal migratory pelagics, enforcement would be difficult because agents would not be able to discern whether fishers are spearing reef fish or allowable species. This alternative would result in regulations identical to **Alternative 1** since Council-managed reef fish is already prohibited under Action 2. Under the proposed alternatives for Action 2, Council-managed reef fish cannot be harvested or possessed in one or more of the three areas, therefore, there is an implicit spear prohibition.

Preferred Alternative 3 and **Alternative 4** would prohibit spearfishing for all non-HMS-managed species, including Council-managed reef fish and coastal migratory pelagics. Spearfishing for HMS species is addressed in Action 5. Under **Preferred Alternative 3**, fishers could not use spear anywhere within the federal portions of the three managed areas to harvest any non-HMS-managed species during the seasonal closure established in Action 1. **Alternative 4** would prohibit the use of spear for all non-HMS-managed species for the entire year. This alternative is the most restrictive; however, it provides the best protection to all resources and facilitates enforcement.

Under **Alternative 2, Preferred Alternative 3**, and **Alternative 4**, the Council has the option to select the alternative for one or multiple areas. Selecting each sub-alternative under the alternatives would result in consistent regulations among the three managed areas in federal waters. However, if the Council chooses a different combination of alternatives, inconsistencies among the three areas would remain. For instance, if the Council selects **Preferred Sub-Alternative 3a**, **3b,** and **Sub-Alternative 2c**, Bajo de Sico

and Abrir La Sierra Bank would have consistent regulations but Tourmaline Bank would not be consistent with those two. This would not facilitate enforcement or avoid confusion among constituents.

Under each of the alternatives, including **Preferred Alternative 3**, the current year-round restrictions on bottom-tending gear (pots, traps, bottom longlines, gillnets, and trammel nets) would still apply. Fishers would still not be able to use such bottom-tending gear. This prohibition would provide additional protection to the important benthic habitat.

Chapter 3. Affected Environment

3.1 Physical/Habitat Environment

3.1.1 Abrir La Sierra Bank

Abrir La Sierra Bank is a shelf-edge reef located approximately 23.5 km west of Punta Guaniquilla on the west coast of Puerto Rico (Figure 3.1.1). The insular shelf that leads to Abrir La Sierra Bank is an extensive platform of pavement, sand and coral reef habitats that stands as the largest continuous neritic terrace of the Puerto Rican insular shelf (García-Sais et al. 2010). The bathymetry profile of Abrir La Sierra Bank on the northern edge features a shallow shelf-edge at approximately 15 meters (m) (8 fathoms) and a gradual drop down the insular slope to a depth of 63 m, where the slope rises to a relatively wide terrace as described below. Throughout most of the center and southern sections, the bathymetry at Abrir La Sierra Bank exhibits a primary drop-off from the insular shelf at depths between 20 – 22 m (11 – 12 fathoms). This primary drop-off leads to an outer shelf terrace at depths from 30 - 50 m, extending offshore approximately 0.3 - 0.5 km (García-Sais et al. 2010). In some sections of the outer shelf terrace, the seafloor rises to relatively narrow ridges of variable vertical and horizontal dimensions, with the deeper pools reaching a maximum depth of 50 m. A continuous ridge that rises from the deep outer shelf terrace to depths of 27 – 33 m fringes the shelf-edge, except at the northern edge of Abrir La Sierra Bank. The drop-off at the shelf-edge is typically abrupt, particularly along the southern section. Thus, the main bathymetry features of the mesophotic habitat at Abrir La Sierra Bank within the 30-50 m depth range consist of a series of at least two internal slope walls, a deep outer shelf terrace, and an outer wall insular slope (García-Sais et al. 2010).

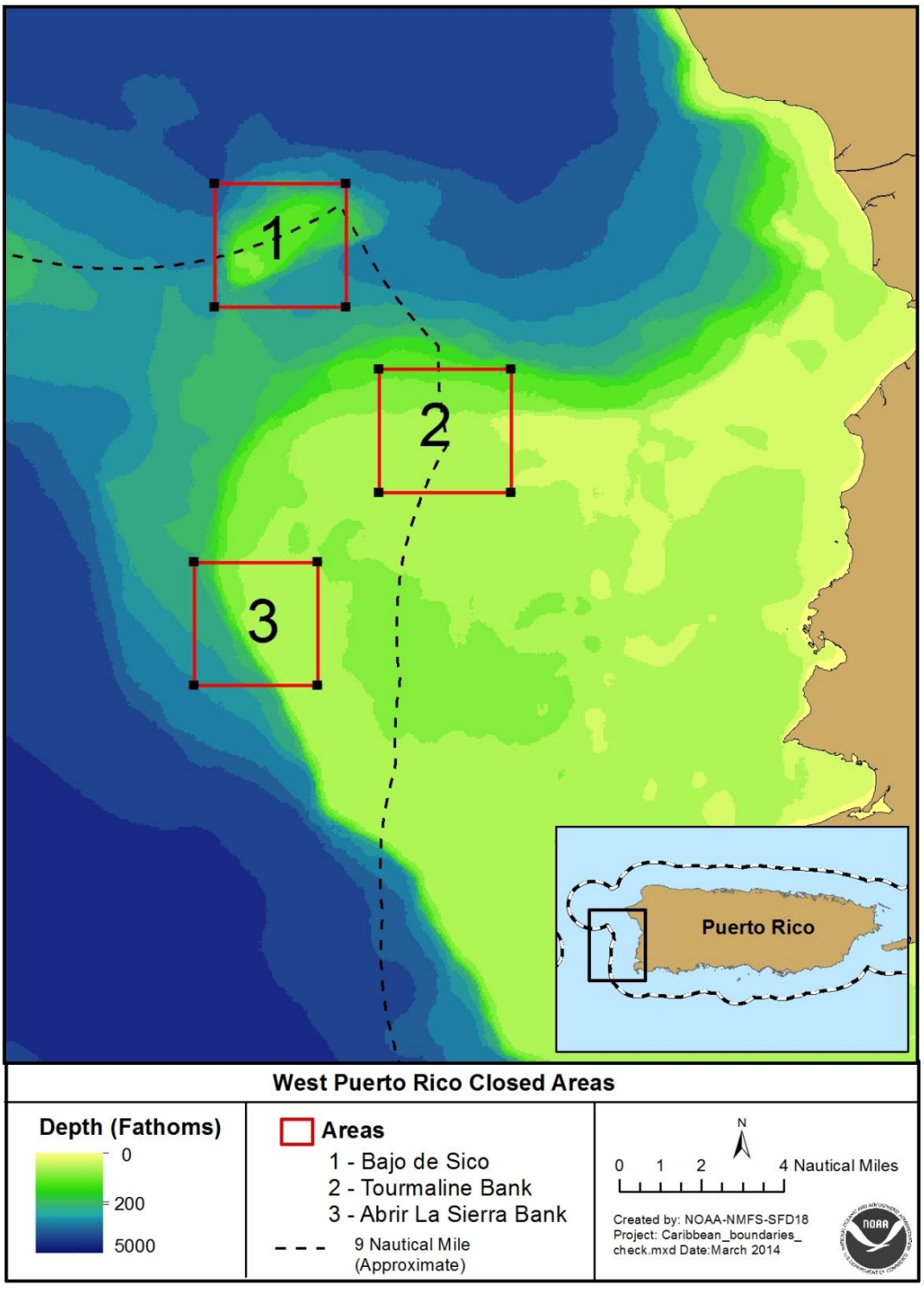


Figure 3.1.1. Bathymetry Of Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank

García-Sais et al. (2010) observed mesophotic benthic habitats at Abrir La Sierra Bank associated with a deep outer shelf terrace separated by two inner walls, and a shelf-edge outer slope wall that represents the upper section of the insular slope. Benthic habitats associated with the deep outer terrace include colonized pavement, rhodolith reefs, a very small section of coral reef, and scattered rhodoliths and sand (García-Sais et al. 2010). Inner walls exhibit moderate live coral cover, consistent with the classification of a coral reef habitat down to a maximum depth of approximately 27 - 28 m. Below 30 m, reef substrate was observed to consist mostly of pavement (hard bottom) colonized by algae, sponges and scattered corals that typically decline in abundance and diversity with increasing depth (García-Sais et al. 2010).

Benthic habitats distributed within the deep terrace include sections of unconsolidated sandy bottoms with scattered rhodoliths and areas of extensive deposits of algal rhodoliths with minimal abiotic cover. García-Sais et al. (2010) found one relatively small coral reef habitat at depths between 30 – 33 m associated with a protected cove within the outer shelf terrace habitat at Abrir La Sierra Bank. Boulder star coral, *Montastraea annularis* was the main structural reef component and was observed to be in good condition (García-Sais et al. 2010).

According to García-Sais et al. (2010), gorgonians are prominent and contribute substantially to the benthic habitat complexity in Abrir La Sierra Bank. Scattered hard ground promontories rising one or two meters from the bottom, with a maximum diameter of about 10 meters, were observed in some sections of the otherwise unconsolidated sandy bottom at the deep terrace. These promontories were typically colonized by sponges, gorgonians and corals, in contrast with the mostly un-colonized condition of the surrounding sandy habitat with scattered rhodoliths. Extensive rhodolith deposits were observed at depths varying between 35 – 50 meters within the outer shelf deep terrace at Abrir La Sierra Bank (García-Sais et al. 2010). Rhodoliths were covered by a dense mat of fleshy algae, particularly the encrusting fan alga, *Lobophora variegata*. Erect and branching sponges were common and represented the main benthic feature providing topographic relief and protective habitat. Rhodolith nodules serve as attachment substrates for sponges and isolated, mostly laminar scleractinian corals (García-Sais et al. 2010).

At a depth of approximately 42 – 45 m, the seafloor at the deep terrace begins to rise again up a steep slope reaching a reef top that runs north-south as a narrow ridge at depths between 27 – 34 m (García-Sais et al. 2010). The benthic habitat at the insular slope wall within the 30 – 50 m study range was observed to be mostly pavement (hard ground) colonized by turf and fleshy algae, sponges, and scattered corals growing as encrusting and massive isolated colonies. Corals did not contribute substantial topographic relief and were not observed to form structurally or biologically complex reef systems (García-Sais et al. 2010).

3.1.2 Bajo de Sico

The Bajo de Sico seamount has a maximum length of approximately 6.0 km along its southwest to northeast axis, and a maximum width of approximately 2.5 km across the northwest to southeast axis. The total surface area of the seamount within the 100 m depth contour is approximately 11.1 km^2 (García-Sais et al. 2007). Bajo de Sico is connected to the insular shelf of Puerto Rico by the deepest and widest of a series of hard ground platforms that extend west and north towards Mona Passage at about 28 km due west off Punta Guanajibo (Figure 3.1.1). The deep shelf platform of Bajo de Sico rises gradually from a depth of 190 m towards the north reaching a minimum depth of 24 m at the top of the seamount. The edge of the deep shelf platform at Bajo de Sico is found at depths that range between 90 – 115 m. The slope of the seamount is an abrupt, almost vertical wall towards the bottom at depths that increase sharply from 200 m in the southern margin to depths of more than 300 m in the northern margin of the seamount (García-Sais et al. 2007).

The most prominent bathymetric feature of Bajo de Sico is a series of promontories located at the southwest margin of the seamount. These promontories rise from a basal depth of approximately 40 m and extend along a southeast to northwest axis, occupying a surface area of approximately 0.4 km^2, or 3.6% of the total seamount surface area within the 100 m depth contour. Depth increases gradually along a series of mostly flat homogeneous platforms oriented towards the northeast, the larger of which sits within the 60 – 70 m depth contours and occupies a surface area of approximately 2.84 km^2, or 25.5% of the total Bajo de Sico shelf surface area (García-Sais et al. 2007).

The total area within the 50 m depth contour is 1.3 km^2, or 11.7% of the seamount's total surface area. A ridge of rock promontories aligned southeast to northwest located on the southern section of the seamount is the main topographic feature of Bajo de Sico. Promontories rise from a hard ground platform at a depth of 40 – 45 m up to a minimum depth of 23.5 m on the northwestern margin of the ridge. There is an additional promontory that stands as a solitary mount rising to a depth of 27.0 m at the southern tip of the seamount (García-Sais et al. 2007). Rock promontories exhibit two main benthic habitats, the reef top and the reef wall. The reef top habitat is highly irregular, with many substrate discontinuities, outcrops, holes, crevices and the rugosity contributed by large erect sponges and some massive corals. It is a horizontally protruded, well lit hard ground surface characterized by a distinct assemblage of reef biota dominated by benthic algae and sponges. Scleractinian corals present their highest substrate cover at the reef top (García-Sais et al. 2007).

The reef wall is a vertically protruded, highly irregular habitat, with caves, gaps, and holes at the wall's face, and undercuts near the base. Light intensity declines rapidly with increasing depth down the reef wall, and instead of benthic algae, the substrate at the wall is dominated by sponges (García-Sais et al. 2007). Instead of scleractinian corals, gorgonians and black corals are prominent at the reef wall. Also, benthic algae are less prominent at the reef wall, compared to the reef top. The total surface area of the

reef promontories (including the reef top and wall habitat) was calculated by García-Sais et al. (2007) as 0.40 km^2, representative of 3.6% of the total seamount area.

García-Sais et al. (2007) observed a highly heterogeneous benthic habitat of colonized pavement and sand on channels separating adjacent promontories, and surrounding the ridge at its base within a depth range of 40 – 45 m. Isolated coral heads, sometimes associated with sponges, gorgonians, colonial hydrozoans, and benthic algae colonize the hard ground between and around promontories. Coarse sand and rubble occur within the channels separating promontories, whereas the habitat surrounding the rock promontories presents uncolonized gravel and small rhodoliths dispersed over a compacted sandy substrate that gradually slopes down to the main platform of the seamount. An array of rock promontories were present interspersed within the slope (García-Sais et al. 2007).

An extensive hard ground platform that extends north of the main seamount ridge was found at depths between 45 – 90 m (García-Sais et al. 2007). The total surface area of the deep platform below 50 m was estimated at 9.82 km^2, representing 88.2% of the seamount surface area. The shelf edge is an abrupt vertical wall mostly throughout the seamount, except along the southeast section where the seamount appears to be connected to the main island of Puerto Rico by a horizontal displacement of the insular slope forming a deep terrace at a depth of 177 m (García-Sais et al. 2007).

The deep shelf platform of Bajo de Sico, down to the maximum surveyed depth of 50 m, was found to be mostly covered by a vast deposit of algal rhodoliths (García-Sais et al. 2007). Two main benthic habitats can be discerned from this deep platform section of Bajo de Sico. At the northern section of the platform, rhodoliths and other relict carbonate materials are densely overgrown by benthic algae, mostly the encrusting alga, *Lobophora variegata*, sponges, and scleractinian corals. Although of low topographic relief, the sharp increment in biotic cover and biodiversity relative to the adjacent slope environment serve as criteria to classify this habitat as a mesophotic reef system (García-Sais et al. 2007). South of the main ridge and at the western and eastern edges of the ridge, extensive rhodoliths deposits were also found. In contrast to the northern section, rhodolith nodules were mostly uncolonized by encrusting reef biota and appeared to be in a more dynamic state, as suggested by ripple formations observed in some areas (García-Sais et al. 2007).

3.1.3 Tourmaline Bank

García-Sais et al. (2013) observed five main benthic habitat types within Tourmaline Bank. These included a mostly unconsolidated and abiotic sandy substrate; scattered patch reefs surrounded by sand; colonized pavement; algal rhodolith reef deposits; and a slope wall rocky habitat. Within the entire 30 – 50 m range of Tourmaline Bank, sand was the main substrate type in terms of areal cover, accounting for approximately 6.7 km^2, or 48.1% of the total study area. The formation of ripples indicates that this sediment is in dynamic state and thus has a high potential for abrasion, which may limit the growth of corals and the formation of coral reefs within this habitat type.

Small, scattered patch reefs of variable dimensions, not exceeding 20 m in diameter, were observed mostly within the northeast section of the sandy habitat at depths of 30 – 40 m, covering an estimated 0.27 km^2, or 1.9% of the total study area (García-Sais et al. 2013). These patch reefs appear to be small hard bottom outcrops that rise above the sand deposit. The virtual absence of live coral from these patch reefs and the abundance of erect sponges suggest that these features may be sporadically covered by sand in what appears to be a zone of highly dynamic inshore-offshore sand transport. Evidently, the mesophotic zone at Tourmaline Bank is an interface, or transition zone, between the extensive sand deposit of the relatively wide insular shelf and the insular slope ((Figure 3.1.1; García-Sais et al. 2013).

Reaching towards the shelf edge, a low relief hard ground platform largely colonized by turf algae and other encrusting biota was found and categorized by García-Sais et al. (2013) as the colonized pavement habitat. Total areal cover of colonized pavement within the 30 – 50 m depth range at Tourmaline Bank was 1.41 km^2, or 10.1% of the total area surveyed. This substrate appears be the underlying hard bottom of the insular platform that remains uncovered by sand and has been colonized by benthic algae and other encrusting biota, particularly sponges. In observations made by García-Sais et al. (2013), the colonized pavement habitat was not uniform across any considerable distance and varied markedly in terms of its colonizing biota from place to place. Sand pockets were found interspersed within the pavement and algal nodules, or rhodoliths, were commonly present in sandy/rubble pockets. Scleractinian corals were present in very low density and growing mostly as encrusting colonies of small size that did not contribute in any significant way to the topographic relief and its associated structural/biological complexity within the colonized pavement habitat (García-Sais et al. 2013).

García-Sais et al. (2013) found that rhodolith reef deposits were the most prominent benthic habitat present along the western section of the mesophotic outer shelf, and represented the dominant biotic habitat in terms of areal cover with 5.19 km^2, or 37.5% of the total study area within the 30 – 50 m depth range. The rhodolith reef at Tourmaline Bank is actually the northern extension of a rhodolith habitat corridor that prevails throughout the deep outer shelf basin at Abrir La Sierra Bank and that was described as the main habitat for a reproductively active population of adult queen conch (Garcia-Sais et al. 2010; García-Sais et al. 2013). García-Sais et al. (2013) hypothesized that rhodoliths are in dynamic motion since they did not present any colonization by corals or large sponges. The main colonizing agent observed was the encrusting fan alga, *Lobophora variegata*. Erect barrel sponges, *Xestospongia muta* were the most important contributor to topographic relief at the rhodolith reef (García-Sais et al. 2013).

Near the middle of the study area there is a bend with an almost 90 degree eastward projection from its due south wing. Around this corner, the shelf-edge exhibits an abrupt, vertically projected wall that steps down from a gradually sloping shelf at 40 m to a platform at 60 m (García-Sais et al. 2013). Despite its low areal cover of 0.31 km^2, or 2.3% of the study area, this wall feature of the insular slope is very important as a habitat for large demersal fishes and appears to represent the upper habitat range of deep-sea snappers such as the blackfin snapper, *Lutjanus buccanella* (García-Sais et al. 2013).

Coral reef habitats within the 30 – 50 m depth range were very scarce at Tourmaline Bank. García-Sais et al. (2013) found an extensive coral reef system associated with the shelf-edge that has developed in depths ranging from 10 m to 28 m. The shelf-edge at Tourmaline Bank exhibits a series of steps with hard ground terraces where coral reefs have developed (García-Sais et al. 2013). There are sections where live scleractinian corals associated with the reef system extend down to 30 m, but at this depth they occur mostly as isolated colonies (García-Sais et al. 2013).

3.2 Biological and Ecological Environment

3.2.1 Species Descriptions

This section summarizes the available information on the biology, life history, and status of species managed by the Caribbean Fishery Management Council (Council). Below are some examples of species managed under the Caribbean Reef Fish Fishery Management Plan (FMP), with more details for species known to occur within Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. Detailed identification and description of essential fishing habitat (EFH) for managed species can be found in the EFH FSEIS (CFMC 2004).

3.2.1.1 Reef Fish

3.2.1.1.1 Snappers, Lutjanidae

The Lutjanidae family contains 103 species in 17 genera, distributed in the tropical and subtropical Atlantic, Indian, and Pacific Oceans (Nelson 1984 in Froese and Pauly 2002). These fishes are generally slow-growing and moderately long-lived. Sexes are separate (Thompson and Munro 1974a). Some species are sequential hermaphrodites, but no indications of hermaphroditism have been observed for Caribbean Council-managed species. Genera represented in the Caribbean reef fish fishery management unit (FMU) include *Apsilus*, *Etelis*, *Lutjanus*, *Ocyurus*, *Pristipomoides,* and *Rhomboplites*.

Most species are believed to exhibit sexually dimorphic growth rates and sizes at maturity (Thompson and Munro, 1974a). These fishes are generally serial spawners, releasing several batches of eggs over a spawning season that sometimes extends throughout the year (SAFMC 1999). Spawning activity generally peaks in the spring and summer months in the northeastern Caribbean (Erdman 1976). Annual fecundity reportedly ranges from one hundred thousand eggs released by young snappers and smaller species, to millions of eggs released by older snappers and larger species (SAFMC 1999; Thompson and Munro 1974a).

All species have complex life histories, with most dependent on different habitats during the egg, larval, juvenile, and adult phases of their life cycle. No long-lived oceanic larval or post-larval phases have been reported for snappers, as have been reported for many other reef fish families. Thus, they probably have a relatively short planktonic larval or post-larval life (Thompson and Munro 1974a). Larvae settle into various nearshore nursery habitats such as seagrass beds, mangroves, oyster reefs, and marshes (AFS 2001). Very early juvenile stages of snappers are not often seen but do not appear to be as secretive as hinds and groupers (Thompson and Munro 1974a).

Adults are generally sedentary and residential. Movement is generally localized and exhibits an offshore-inshore pattern, usually associated with spawning events. Many species have been reported to form mass spawning aggregations, where hundreds or even thousands of fish convene to reproduce (Rielinger 1999). Other species also aggregate to swim (SAFMC 1999). Generally, larger snappers inhabit deeper areas than smaller snappers, although there are many exceptions.

Juveniles occupying inshore areas generally feed on shrimp, crab, worms and small fish. Fish becomes a more important component of their diet as they grow and move offshore (SAFMC 1999). On reefs, snappers must certainly compete among themselves for food and space. A 1967 study reported that snappers in the Virgin Islands feed primarily on crabs and fishes, with shrimps, lobsters, gastropods, stomatopods and octopus completing the diet (Thompson and Munro 1974a). Competition with groupers (Serranidae), jacks (Carangidae), moray eels (Muraenidae), and grunts (Pomadasyidae) probably also occurs, although the extent of competition is not known. Predators of juvenile snappers include large carnivorous fishes, such as jacks, groupers, sharks, barracudas, and morays, as well as large sea mammals and turtles (SAFMC 1999). Major reef predators such as sharks, groupers and barracuda are probably the most important predators of adult snappers (Thompson and Munro 1974a).

Dog snapper, *Lutjanus jocu*

The dog snapper occurs in both the Western and Eastern Atlantic. In the Western Atlantic, it ranges from Massachusetts southward to northern Brazil, including the Gulf of Mexico and Caribbean Sea. This species is taken in commercial fisheries and also is utilized in the aquarium trade. It can be ciguatoxic (Allen 1985).

The dog snapper is found from 5 – 30 m depth. Adults are common around rocky or coral reefs. Young are found in estuaries, and occasionally enter rivers (Allen 1985). This species is of low resilience, with a minimum population doubling time of 4.5 – 14 years ($K = 0.10$; $t_m = 5.5$). Maximum reported size is 128 cm total length (TL) (male); maximum weight, 28.6 kg (Allen 1985). Size at maturity and age at first maturity are estimated as 47.6 cm TL and 6.2 years, respectively. Approximate life span is 28.7 years; natural mortality rate, 0.333 (Ault et al. 1998). Dog snapper are reported to spawn throughout the year off Cuba (García-Cagide et al. 1999). A Caribbean study collected ripe females in February-March, and one ripe female and one spent male in November (Thompson and Munro 1974a). In the northeastern Caribbean, individuals in spawning condition have been observed in March (Erdman 1976). Table 4.1.2.1

in Section 4.1.2 summarizes dog snapper spawning periods. The dog snapper feeds mainly on fishes and benthic invertebrates, including shrimps, crabs, gastropods and cephalopods (Allen 1985).

Schoolmaster snapper, *Lutjanus apodus*

The schoolmaster snapper occurs in both the Western and Eastern Atlantic Oceans. In the Western Atlantic, its range extends as far north as Massachusetts, southward to Trinidad and northern Brazil, including the Gulf of Mexico and Caribbean Sea. This species is considered to be a good food fish (Allen 1985). However, Dammann (1969) reports that it can be ciguatoxic.

The schoolmaster snapper is found in shallow, clear, warm, coastal waters over coral reefs, from 2 – 63 m depth. Adults often seek shelter near elkhorn corals and gorgonians. Juveniles are encountered over sand bottoms with or without seagrass (*Thalassia*), and over muddy bottoms of lagoons or mangrove areas. Young sometimes enter brackish waters (Allen 1985).

Allen (1985) reports maximum sizes as 67.2 cm TL and 75 cm fork length (FL) for males and females, respectively. The maximum fork length of females captured in a Jamaican study was 57 cm (Thompson and Munro 1974a). Maximum reported weight is 10.8 kg (Allen 1985). Size at maturity is estimated as 37.7 cm TL; natural mortality rate, 0.25 (Ault et al. 1998). Ripe and/or recently spent fishes have been collected in nearshore and oceanic habitats off Jamaica in February-June and August-November (Thompson and Munro 1974a). Erdman (1976) reports the occurrence of ripe males and females in September. Schoolmaster are reported to spawn during April-June off Cuba (García-Cagide et al. 1994).

This schoolmaster snapper sometimes forms resting aggregations during the day (Allen 1985). Schools of this species observed over reefs off Florida dispersed at dusk in search of food (Thompson and Munro 1974a). Prey items include fishes, shrimps, crabs, worms, gastropods and cephalopods (Allen 1985).

Yellowtail snapper, *Ocyurus chrysurus*

The yellowtail snapper occurs in the Western Atlantic, ranging from Massachusetts to southeastern Brazil, including the Gulf of Mexico and Caribbean Sea. This species is most common in the Bahamas, off south Florida, and throughout the Caribbean. It is taken in both the commercial and recreational fisheries, is cultured commercially, and is utilized in the aquarium trade (Allen 1985). Dammann (1969) reports that it can be ciguatoxic.

The yellowtail snapper inhabits waters to 180 m depth, and usually occurs well above the bottom (Allen 1985). A Jamaican study reports this species was most abundant at depths of 20-40 m near the edges of shelves and banks (Thompson and Munro 1974a). Early juveniles are usually found over seagrass beds (Allen 1985; Thompson and Munro 1974a). Later juveniles inhabit shallow reef areas. Adults are found on deeper reefs (Thompson and Munro 1974a). This fish wanders a bit more than other snapper species (SAFMC 1999), but the extent of its movement is unknown. It also exhibits schooling behavior (Thompson and Munro 1974a).

This species is of low resilience, with a minimum population doubling time of 4.5-14 years (K = 0.10-0.16; t_m = 2; t_{max} = 14). Maximum reported size is 86.3 cm TL (male); maximum weight, 4,070 g (Allen 1985). Size at maturity and age at first maturity are estimated in Froese and Pauly (2002) as 42.5 cm TL and 4 years, respectively. Figuerola and Torres (1997) estimate size at 50% maturity as 22.4 cm FL (males) and 24.8 cm FL (females), based on fishery independent and dependent data collected off Puerto Rico. Maximum reported age is 14 years (Allen 1985); estimated natural mortality rate, 0.21 (Ault et al. 2002).

Spawning extends over a protracted period, peaking at different times in different areas (Allen 1985; Figuerola and Torres 1997). Figuerola and Torres (1997) report that, in the U.S. Caribbean, the reproductive season of this fish extends from February to October, with a peak from April to July. Erdman (1976) reports that 80% of adult yellowtails captured off San Juan from March through May, and over Silver Bank in early September, had ripe or sub-ripe gonads. Table 4.1.2.1 in Section 4.1.2 summarizes yellowtail snapper spawning periods. Evidence indicates that spawning occurs in offshore waters (Figuerola and Torres 1997; Thompson and Munro 1974a) and during the new moon (Figuerola and Torres 1997). Fecundity ranged from 100,000 to 1,473,000 eggs per fish in four individuals captured off Cuba (Thompson and Munro 1974a).

Juvenile yellowtail snapper feed primarily on plankton (Allen 1985; Thompson and Munro 1974a). Adults feed mainly at night on a combination of planktonic (Allen 1985), pelagic (Thompson and Munro 1974a), and benthic organisms, including fishes, crustaceans, worms, gastropods and cephalopods (Allen 1985).

3.2.1.1.2 Groupers, hinds, and sea basses, Serranidae

The Serranidae family contains 449 species in 62 genera, distributed in tropical and temperate oceans across the globe. These species are monoecious, with some functional hermaphrodites (Nelson 1994). Protogynous hermaphroditism is known to occur in several species of groupers, although in related serranids synchronous hermaphroditism is also encountered. A broad overlap of the length distributions of the sexes is encountered in most species and suggests that there is no close correlation of age or size with sexual transition (Thompson and Munro 1974b). Many groupers, but especially the largest *Epinephelus* species, appear to be the resident apex predators of the reef systems that they inhabit (Huntsman et al. 1999).

Red hind, *Epinephelus guttatus*

The red hind occurs in the Western Atlantic, ranging from North Carolina to Venezuela, including the Caribbean Sea. An excellent food fish, this species is readily caught on hook and line and is easily speared by divers. It is taken in both commercial and recreational fisheries, and is utilized in the aquarium trade (Heemstra and Randall 1993). Halstead (1970) reports that it can be ciguatoxic.

The red hind is found in shallow reefs and rocky bottoms, from 2 – 100 m depth. It is usually solitary and territorial. This species is moderately resilient, with a minimum population doubling time of 1.4 – 4.4 years (K=0.12-0.24; t_m=3; t_{max}=17; Fec=96,000). Maximum reported size is 76 cm TL (male); maximum weight, 25 kg (Heemstra and Randall 1993). Size at maturity and age at first maturity are estimated in Froese and Pauly (2002) as 31.4 cm TL and 5.5 years, respectively. Figuerola and Torres (2000) estimate size at maturity as 21.7 cm FL based on data collected in a study conducted off the west coast of Puerto Rico. The approximate life span of this fish is 23.8 years; natural mortality rate, 0.18 (Ault et al. 1998). One study showed 233,273 eggs for a specimen of 35.8 cm standard length (SL) (Thompson and Munro 1974b).

The red hind is a protogynous hermaphrodite (Thompson and Munro 1974b). Thompson and Munro (1974b) report that mean size at sex reversal appears to be in the region of 38 cm TL. But, according to Heemstra and Randall (1993), some individuals have been observed to undergo sexual inversion at just 28 cm TL. CFMC (1985) reports size at sex reversal as 35 cm TL. Most fish larger than 40 cm are males, which is important in terms of numbers caught and total weight of landings in the Caribbean (Heemstra and Randall 1993).

This species aggregates in large numbers during the spawning season (Coleman et al. 2000; Sadovy et al. 1994). A number of spawning aggregation sites have been documented in the U.S. Caribbean. Three sites are located off the western coast of Puerto Rico. A fourth site is located near the shelf edge off the southwest coast of Puerto Rico, El Hoyo and La Laja, and is utilized by as many as 3,000 individuals at 20 – 30 m depth. A fifth site is located on the Lang Bank, east-northeast of St. Croix, and is characterized by aggregations from 38-48 m depth. Finally, a sixth site is located south of St. Thomas, U.S. Virgin Islands (USVI). That aggregation also generally occurs at 38 – 48 m depth. The timing of aggregations is somewhat variable. Aggregations off Puerto Rico generally occur from January through March in association with the full moon, while those off the USVI generally occur from December through March in association with the full moon (Rielinger 1999). Table 4.1.2.1 in Section 4.1.2 summarizes red hind spawning periods. The red hind feeds mainly on crabs and other crustaceans, fishes, such as labrids and haemulids, and octopus (Heemstra and Randall 1993).

Nassau grouper, *Epinephelus striatus*

The Nassau grouper occurs in the tropical Western Atlantic, ranging from Bermuda, the Bahamas, and Florida to southern Brazil. It is not known in the Gulf of Mexico, except at the Campeche Bank off the coast of Yucatan, at Tortugas, and off Key West. This species is a popular food fish and also is utilized in the aquarium trade (Heemstra and Randall 1993). However, the take and possession of Nassau grouper is prohibited in federal waters. Furthermore, Puerto Rico implemented new regulations on March 12, 2004, to prohibit the possession or sale of Nassau grouper. Olsen et al. (1984) report that it can be ciguatoxic.

The Nassau grouper occurs from the shoreline to at least 130 m depth (Sadovy de Mitcheson et al. 2012). It is a sedentary and reef-associated species, usually encountered close to caves; although juveniles are common in seagrass beds (Heemstra and Randall 1993). Adults lead solitary lives outside of spawning aggregations (NMFS 2001).

This fish is of low resilience, with a minimum population doubling time of 4.5 – 14 years (Froese and Pauly 2002). Maximum reported size is 122 cm TL (male); maximum weight, 25 kg (Heemstra and Randall 1993). Size at maturity and age at first maturity are estimated as 47.5 cm TL and 6.9 years, respectively. Maximum reported age is reported at 29 years (Sadovy de Mitcheson et al. 2012). Ault et al. (1998) estimate natural mortality rate to be 0.18.

This fish was initially characterized as a protogynous hermaphrodite. But recent investigations of histological and demographic data, and the nature of the mating system, indicate that Nassau grouper may not be strictly protogynous. Thus, it has been characterized as gonochoristic (separate sexes), with a potential for sex change (NMFS 2001; Sadovy de Mitcheson et al. 2012). One study reported 785,101 eggs for a specimen of 35.8 cm SL (Thompson and Munro 1974b). Sexual maturity for both sexes is reached between 40 and 45 cm TL and at about 4 years old (Sadovy de Mitcheson et al. 2012).

The Nassau grouper aggregates to spawn at specific times and locations each year (Coleman et al. 2000; Sadovy et al. 1994), reportedly at some of the same sites utilized by the tiger, yellowfin, and black groupers (Sadovy et al. 1994). Concentrated aggregations of a few dozen (NMFS 2001) up to 30,000 Nassau groupers have been reported from the Bahamas, Jamaica, Cayman Islands, Belize, and the Virgin Islands (Heemstra and Randall 1993). Rielinger (1999) documented spawning aggregations composed of about 2,000 individuals north and south of St. Thomas, USVI, at 10 – 40 m depth, from December through February, around the time of the full moon.

According to NOAA's National Marine Fisheries Service (NMFS) (NMFS 2001), spawning aggregations occur in depths of 20 – 40 m at specific locations of the outer reef shelf edge, always in December and January around the time of the full moon in waters 25 – 26 degrees Celsius. Thompson and Munro (1974b) indicate that the spawning season probably extends from January to April in Jamaican waters. They report that spawning aggregations lasting up to two weeks have been encountered annually during late January to early February around the Cayman Islands (Thompson and Munro 1974b). In the northeastern Caribbean, individuals in spawning condition have been observed in March (Erdman 1976). Sadovy de Mitcheson et al. (2012) reported Nassau grouper spawning activity occurs around the full moon, usually between December and March. Table 4.1.2.1 in Section 4.1.2 summarizes Nassau grouper spawning periods.

Nassau grouper are a top-level predator. Juveniles feed mostly on crustaceans, while adults (>30 cm) forage alone, mainly on fish (NMFS 2001) but also on crabs and, to a lesser extent, other crustaceans and mollusks (Heemstra and Randall 1993).

Yellowfin grouper, *Mycteroperca venenosa*

The yellowfin grouper occurs in the Western Atlantic, ranging from Bermuda to Brazil and the Guianas, including the Gulf of Mexico and Caribbean Sea. This species is taken in both commercial and recreational fisheries, and also is utilized in the aquarium trade. Although often implicated in ciguatera poisonings, it is a desirable food fish. Even large (5 – 10 kg) fish are sold, if they are harvested from areas that are considered to be safe from ciguatera (Heemstra and Randall 1993).

The yellowfin grouper occurs from 2 – 137 m depth. Juveniles are commonly found in shallow turtle grass beds; adults, on rocky and coral reefs. This fish is of low resilience, with a minimum population doubling time of 4.5 – 14 years (K=0.09 – 0.17; t_{max}=15; Fec=400,000). Maximum reported size is 100 cm TL (male); maximum weight, 18.5 kg (Heemstra and Randall 1993). Size at maturity and age at first maturity are estimated as 45.6 cm TL and 3.7 years, respectively. Approximate life span is 16.9 years; natural mortality rate, 0.18 (Ault et al. 1998). This fish is believed to be a protogynous hermaphrodite. One studied specimen contained a total of 1,425,443 eggs (Thompson and Munro 1974b). The yellowfin grouper reportedly aggregates at some of the same sites utilized by the tiger, Nassau, and black groupers (Sadovy et al. 1994). Three spawning aggregation sites have been documented off the USVI. Sites located north and south of St. Thomas are utilized from February through April. A third site located in the USVI National Park off St. John, USVI, is utilized year-round. Individuals aggregating at that site number about 200 (Rielinger 1999). Spawning has been observed in Puerto Rican waters in March. Most spawning appears to occur in Jamaican waters between February and April (Thompson and Munro 1974b). Table 4.1.2.1 in Section 4.1.2 summarizes yellowfin grouper spawning periods. It feeds mainly on fishes (mostly on coral reef species) and squids (Heemstra and Randall 1993).

Tiger grouper, *Mycteroperca tigris*

The tiger grouper occurs in the Western Atlantic, ranging from Bermuda and south Florida to Venezuela and, possibly, Brazil, including the Gulf of Mexico and Caribbean Sea. Easily approached, this species is taken in commercial fisheries and also is utilized in the aquarium trade (Heemstra and Randall 1993). Dammann (1969) reports that it can be ciguatoxic.

A solitary species, the tiger grouper inhabits coral reefs and rocky areas, from 10 – 40 m depth. This fish is of low resilience, with a minimum population doubling time of 4.5 – 14 years (K=0.11; t_m=6.5 – 9.5). Maximum reported size is 101 cm TL (male); maximum weight, 10,000 g (Heemstra and Randall 1993). Size at maturity and age at first maturity are estimated as 39.9 cm TL and 5.8 years, respectively. Approximate life span is 26 years; natural mortality rate, 0.116 (Ault et al. 2002). The size-sex ratios described in a Bermuda study indicate this fish is probably a protogynous hermaphrodite (Heemstra and Randall 1993). It forms aggregations at specific times and locations each year, but only during the spawning season (Coleman et al. 2000; Matos and Posada 1998). A presumptive courting group of three tiger groups also has been observed off the Bahamas, indicating that courtship also may occur in small groups (Sadovy et al. 1994).

One known aggregation site in the U.S. Caribbean is a well-defined promontory of deep reef known as "El Seco," which is located about 4.7 nautical miles (nm) east of Vieques Island, Puerto Rico. The "El Seco" tiger grouper aggregation is routinely targeted by fishermen using spear guns and hook and line gear. This fish is only infrequently taken outside of the aggregation season and is not taken by fish traps in the area (Matos and Posada 1998; Sadovy et al. 1994). The aggregation begins about two days after the full moons of February and March and last for about 5-6 days (Matos and Posada 1998). Females taken from the "El Seco" aggregation in 1997 and 1998 averaged 46.2 cm TL and 48.2 cm TL, respectively; males averaged 53.4 cm TL and 54.0 cm TL, respectively. The female to male ratio was 1:6.4 in 1997 and 1:12.0 in 1998 (Matos and Posada 1998). White et al. (2002) reported that spawning aggregations of tiger grouper occur one week following the full moon during January through April off Puerto Rico.

3.2.1.1.3 Other Reef Fish Species

Parrotfishes, Scaridae

The Scaridae family contains 83 species in 9 genera, distributed in the Atlantic, Indian, and Pacific Oceans (Gilbert and Williams 2002). The 10 species in the Caribbean reef fish FMU belong to two genera: *Scarus* and *Sparisoma*. All these species are marketed for food, but are considered to be of minor importance to commercial fisheries in Puerto Rico and St. Thomas/St. John. With the exception of the midnight parrotfish, *Scarus coelestinus*, all are utilized in the aquarium trade (CFMC 2013).

Parrotfish are tropical shallow-water fishes that commonly occur on or adjacent to coral reef habitats but also can be found over rocky shores and substrates, as well as neighboring sea grass beds. They have a tendency to exhibit residential behavior for variable periods of time, but may move over distances of up to several hundred meters during feeding (Reeson 1975). These fishes are omnivorous herbivores. Most species feed on algae scraped from dead coral substrates. However, some parrotfish also graze upon coral polyps and various other invertebrate species (Yoshioka 2008; Rotjan and Lewis 2006; Ogden and Buckman 1973). Three feeding modes (browsing, scraping, and excavating) have been identified for parrotfish, resulting in different ecological and biosystematic outcomes (Molina-Ureña 2009). The common practice of consuming and crushing bits of rock along with the algae to aid in the digestive process make these fishes some of the most important producers of sand on coral reefs (Humann and DeLoach 2002; Gilbert and Williams 2002).

Parrotfish are diurnally active, feeding during the day and resting at night. They tend to aggregate in shallow waters near dusk, then move to deeper areas before nightfall. Parrotfish undergo a form of sleep at night, in which some species may secrete a transparent, protective cocoon made from mucus (Humann and DeLoach 2002; Robins and Ray 1986; Gilbert and Williams 2002). Mixed species aggregations may occur, or the schools may also contain representatives of other families. For example, it is common around Jamaica to find members of the Surgeonfish (Acanthuridae), Goatfish (Mullidae), Grunt

(Pomadasyidae) and Wrasse (Labridae) families in association with the usually numerically dominant striped parrotfish (*Scarus iseri*) (Humann and DeLoach 2002; Robins and Ray 1986; Reeson 1975).

Many species undergo sex reversal. Both male and female exhibit a drab initial phase as juveniles.. Females then commonly transition into a brilliantly colored male terminal phase. Females from the genus Scarus will always turn into males if they live long enough, but the transition into males cannot occur before they are sexually mature (Hawkins and Roberts 2003). On the other hand, some females from the genus Sparisoma do not appear to transition into males, no matter how big they grow. However, a small percentage may turn into males before they reach sexual maturity. In the Caribbean, all individuals from the genus Sparisoma are born female whereas some individuals from the genus Scarus are born male. This pattern has not been seen outside the Caribbean (Hawkins and Roberts 2003). Fish born male are known as primary males, while individuals that have changed sex are called secondary males. There is no evidence that any species of parrotfish can undergo a sex change reversal (Hawkins and Roberts 2003).

Parrotfish are pelagic spawners; some spawn in pairs; others in small groups or aggregations (Reeson 1975). Juveniles are present in the northeastern Caribbean year-round (Erdman 1976).

Triggerfish, Balistidae

The Balistidae family contains 40 species in 11 genera, distributed in the Atlantic, Indian, and Pacific Oceans (Nelson 1994). Only 4 genera are represented in the Caribbean reef fish FMU: *Balistes*, *Canthidermes*, *Melichthys*, and *Xanthichthys*. These fish are popular and hardy aquarium trade species, but are often aggressive (Nelson 1994). They are also a popular target of subsistence fishing on many islands.

Jacks, Carangidae

The Carangidae family contains 140 species in 33 genera, distributed in the Atlantic, Indian, and Pacific Oceans. Jacks are some of the most important tropical marine fishes for commercial, subsistence, and recreational fisheries (Nelson 1984). Only two genera are represented in the Caribbean reef fish FMU: *Caranx* and *Seriola*.

Butterflyfishes, Chaetodontidae

The Chaetodontidae family contains 114 species of butterflyfishes in 10 genera, distributed in the tropical Atlantic, Indian, and Pacific Oceans (Nelson 1994). Burgess (1978) reports that these residential fishes occur as individuals, commonly as pairs strongly or loosely bound together, as small groups of three or more, and as relatively large aggregations for feeding and, possibly, for spawning. But a study conducted in Jamaican waters noted that no schooling behavior has been reported for the four *Chaetodon* species included in the Caribbean reef fish FMU, rather they tend to occur in smaller groups (Aiken 1975). The authors of that study report that butterflyfishes of this genus usually occur in pairs; generally male and female. This is supported by reports that butterflyfish enter fish traps in pairs in the Virgin Islands (Aiken 1975). It is suspected that these pairs form early in life, but stay together for purposes of spawning (Burgess 1978). Butterflyfishes are highly fecund (one gonad count showed 3,000-4,000 eggs) (Burgess

1978), producing many more eggs/g body weight than the angelfishes (Aiken 1975). Eggs (Nelson 1994) and, possibly, early juveniles (Aiken 1975), are pelagic.

These fishes are typically diurnal (Nelson 1994), and have been observed to feed on small invertebrates, including coral polyps and planktonic copepods, and, to a lesser extent, algae (Burgess 1978). They also ingest inorganic material such as sand and coral fragments and thus play a direct role in the transport of calcareous fragments by reef fishes (Aiken 1975). Juveniles of many species have been observed removing parasites from other fishes. But, it is believed that the bulk of their food is obtained from other sources, and that parasite-picking behavior is only exhibited on occasion (Burgess 1978). These fishes show no direct evidence of competition among themselves (Aiken 1975). They are preyed on by the same predators as other reef fishes, including moray eels, snappers, scorpionfishes, and groupers. Their diurnal behavior makes them easy prey for night-hunting predators such as moray eels, since they are comatose during the evening hours. CFMC (1985) reports that butterflyfishes in the U.S. Caribbean are consumed by humans in the USVI, but not in Puerto Rico. They are of primary importance to the aquarium trade (CFMC 1985).

Grunts, Haemulidae

The Haemulidae family contains 150 species in 17 genera, distributed in the Atlantic, Indian, and Pacific Oceans (Nelson 1994). Genera represented in the Caribbean reef fish FMU include *Anisotremus* and *Haemulon*. These species are considered to be important food fishes (Nelson 1994), but Olsen et al. (1984) report that all can be ciguatoxic.

The grunts are pelagic spawners (Nelson 1994). Some species are thought to spawn two or more times each year whereas others may spawn more or less continuously throughout the year. Several species are believed to form spawning aggregations. Both eggs and larvae are thought to be pelagic. Settlement takes place in shallow water, and the young of many species school on nursery grounds, such as shallow back-reef areas or grass beds, until reaching maturity when they join the adult schools. Adults of most species typically form schools of a few to several hundred fishes on coral reefs by day, and feed in adjacent areas by night. This schooling behavior is an important factor in trap fishing, as one study has shown that, when a few white grunts entered a trap, conspecific attraction tends to draw in more individuals. Schools of mixed species of grunts are common (Gaut and Munro 1974).

All grunts are carnivores, feeding largely on invertebrates, although some supplement their diet with small fishes. Both the wide variety of food items taken and apparent differences in preferred foods probably reduces the amount of interspecific competition for food. But the grunts do compete for food with many other reef fishes, including porgies (Sparidae), goatfishes (Mullidae), wrasses and hogfishes (Labridae), and mojarras (Gerreidae). Predators include groupers (Serranidae), snappers (Lutjanidae), and jacks (Carangidae) (Gaut and Munro 1974).

Squirrelfishes and Soldierfishes, Holocentridae

The Holocentridae family contains 65 species in 8 genera, distributed in the tropical Atlantic, Indian, and Pacific Oceans. Most members of this family are nocturnal, and hide during the day in crevices or beneath reef ledges, along with cardinalfishes, bigeyes, and sweepers. These fish are hardy aquarium trade species, and also important subsistence food fishes in many areas (Nelson 1994). Genera represented in the Caribbean reef fish FMU include *Myripristis*, *Holocentrus*, and *Priacanthus*.

Wrasses and Hogfish, Labridae

The Labridae family contains 500 species in 60 genera, distributed in the Atlantic, Indian, and Pacific Oceans (Nelson 1994). Three genera are represented in the Caribbean reef fish FMU: *Bodianus*, *Halichoeres*, *Lachnolaimus*. Some of these species are utilized primarily in commercial fisheries; others in the aquarium trade.

Tilefishes, Malacanthidae

The Malacanthidae family contains 40 species in 5 genera, distributed in the Atlantic, Indian, and Pacific Oceans (Nelson 1984). Only two genera are represented in the Caribbean reef fish FMU: *Caulolatilus* and *Malacanthus.* All tilefish live in a burrow, some in a large rubble mound of their own construction, in pairs or colonies (Nelson 1984).

Angelfishes, Pomacanthidae

The Pomacanthidae family contains 74 species in 9 genera, distributed in the tropical Atlantic, Indian, and (mainly western) Pacific Oceans. All species studied to date are protogynous hermaphrodites with a haremic social system (Nelson 1994). Genera represented in the Caribbean reef fish FMU include *Holacanthus* and *Pomacanthus*.

Porgies, Sparidae

The Sparidae family contains 112 species in 35 genera, distributed in tropical and temperate waters of the Atlantic, Indian, and Pacific Oceans. These fish are premier food and game fishes. Many species have been found to be hermaphroditic; some have male and female gonads simultaneously; others change sex as they get larger (Nelson 1994). The spawning season of these fishes is limited (Erdman 1976). Only two genera are represented in the Caribbean reef fish FMU: *Archosargus* and *Calamus*.

3.2.1.2 Spiny Lobster

The Caribbean spiny lobster belongs to the Palinuridae family, which contains about 50 different species of spiny lobsters in 8 genera. The Caribbean spiny lobster, *Panulirus argus* (hereafter referred to as spiny lobster), occurs in the Western Central and South Atlantic Ocean, including the Caribbean Sea and the Gulf of Mexico. North Carolina marks its northernmost limit; Brazil, its southernmost limit (Bliss 1982). This species is taken in commercial, subsistence, and recreational fisheries.

The spiny lobster occurs from the extreme shallows of the littoral fringe to depths of at least 100 m (Kanciruk 1980; Munro 1974). CFMC (1981) reports that its distribution off Puerto Rico extends to the edge of the shelf, which is described as the 100-fathom contour (183 m). Sexes are separate and anatomically distinct. Males have larger and heavier carapaces, but lighter and shorter tails than females. But relationships between total length and total weight are very nearly identical for males and females in Caribbean waters (Munro 1974). Molting appears to be tied to reproduction for females (Munro 1974; Phillips et al. 1980), but males appear to be able to reproduce successfully throughout the year (Phillips et al. 1980).

Maturity occurs at a single molt (the "maturity molt") and is generally related to length, rather than age. According to CFMC (1981), most females reach sexual maturity between 3.1 – 3.5 in (7.9 – 8.9 cm) carapace length (CL) and are at peak egg production between 4.3 – 5 in CL. Intense fishing may have caused a decline in the minimum size of spawning females in Florida waters (CMI 1996). Fecundity varies greatly among size classes, but is generally high. In the early years of a spiny lobster, the larger a female, the more eggs produced. But fecundity begins to decrease at a certain age; possibly around the time when molting decreases in frequency (Munro 1974). Munro (1974) reports that egg production per unit body weight ranges from about 670 to 1,210 eggs/g of total body weight, with an average of 830 eggs/g. The number of eggs ranges from 0.5 – 1.7 million per spawning (CFMC 1981). Kanciruk (1980) estimates maximum age as 20 years.

Spiny lobsters spawn at least once a year (Cobb and Wang 1985). Females in Bermuda have been reported to spawn at least twice (Morgan 1980; Munro 1974) between May and August. But the number of broods produced in Caribbean waters, where the spawning period appears to be more extended, is not known. For most territories within the Caribbean Sea, egg-bearing (berried) females have been observed in all months of the year, but with greatest frequency in the months from February to August (Munro 1974). CFMC (1981) reports that reproduction occurs throughout the year, but declines in the fall.

Fertilization is external (Bliss 1982). Females carry fertilized eggs until they are fully developed (Cobb and Wang 1985), a period of about four weeks, and tend to move towards deeper water when the eggs are ready to hatch (Munro 1974). Embryos hatch as planktonic larvae (Bliss 1982), which spend up to eleven months (Phillips et al. 1980) or more (Munro 1974; Phillips and Sastry 1980) at sea before metamorphosing into the puerulus stage (Cobb and Wang 1985) and settling on the ocean bottom. This extended planktonic stage could permit extremely wide dispersal of the larvae. Thus, it is possible that larvae spawned in the Caribbean could, for example, settle at Bermuda (Munro 1974), although recent work by Butler et al. (2011) suggests the realized dispersal distance may be much shorter.

Shallow areas with mangroves and seagrass (*Thalassia testudinum*) beds serve as nursery areas for pre-adult populations wherever such habitats are available (Munro 1974). Generally, spiny lobsters move offshore when they reach reproductive size (Phillips et al. 1980). Adults are found on most shelf areas which offer adequate shelter in the form of reefs, wrecks or other forms of cover (Munro 1974). This

species shelters communally by day in groups of two to over one hundred (Cobb and Wang 1985) in holes and crevices in reefs or other refuges. The largest dominant male usually occupies the most favored and safest position deep within the refuge. At night, they emerge to feed (Munro 1974).

These animals are primarily carnivores, and serve as the major benthic carnivores in some ecosystems (Kanciruk 1980). They generally feed on smaller crustaceans, mollusks and annelids (Cobb and Wang 1985). One study reported that specimens taken from a lagoon area appeared to feed only on mollusks, but that individuals taken in reef habitat consumed algae, foraminifera, sponge spicules, polychaetes and sand, in addition to bivalve and gastropod mollusk and crustacean remains (Munro 1974). The reported consumption of seaweed, algae, and inorganic material has been attributed both to incidental ingestion (Cobb and Wang 1985) and to a shortage of other food sources (Kanciruk 1980), as opposed to preference. A 1971 study reported that juveniles at the USVI sheltered in daytime aggregations of the sea urchin (*Diadema antillarum*) and thus gained access to extensive feeding areas which were otherwise devoid of shelter (Munro 1974).

Tagging experiments indicate that, with few exceptions, adult spiny lobsters do not usually undertake extensive movements. But some studies show evidence of seasonal inshore-offshore movements, and of extensive mass migrations. Mass migrations have been reported most often from Florida and the Bahamas, where movement is usually southwards (Munro 1974) and occurs in mid-autumn or mid-winter, usually after a period of stormy weather (Cobb and Wang 1985). This migratory behavior is especially striking in the Bahamas, where large numbers of lobsters are observed to migrate day and night in queues of 2 – 60 animals. As many as 100,000 individuals have been observed moving in queue formation in a southerly direction on the shelf area west of Bimini (Cobb and Wang 1985).

The significance of migratory behavior is not yet understood. While local spiny lobster populations travel the same direction each year; populations in other areas may travel in different directions. And return migrations have not been described (Cobb and Wang 1985). Some hypothesize that migrations may serve to redistribute young mature adults in areas appropriate for adult habitation and larval release (Phillips et al. 1980); others, that the lobsters may be trying to escape the stress of severe winters in shallow waters (Cobb and Wang 1985).

Pelagic fishes, including the tunas *Katsuwonus pelamis* and *Thunnus atlanticus*, feed on spiny lobster in their planktonic phase. Natural predators of sub-adult and adult spiny lobster include large benthic feeding fishes, sharks, octopuses (Cobb and Wang 1985), rays, skates, crabs, dolphins (Munro 1974) and turtles (CMI 1996). A small whelk (*Murex pomum*) is reported to eat lobsters in traps, and presumably in nature, by boring through the carapace. Barnacles (*Balanus ebureus*) settle on the carapace of large specimens and could serve as indicators of habitat and of the intermolt period (Munro 1974).

3.2.2 Protected Species

There are 32 different species of marine mammals that may occur in the Caribbean (UNEP 2008). All 32 species are protected under the Marine Mammal Protection Act and five (sperm, sei, fin, blue, and humpback whales) under the purview of NMFS are also listed as endangered under the Endangered Species Act (ESA). Critical habitat has also been designated from elkhorn and staghorn coral ("*Acropora*") and green, hawksbill, and leatherback sea turtles in the Caribbean. Sea turtle critical habitat occurs almost exclusively in Commonwealth and Territorial waters. The potential impacts from the continued authorization of fishing under all four Caribbean FMPs on each of these listed species have been considered in previous ESA Section 7 consultations. Those consultations indicate that of the species listed above, sea turtles and *Acropora* are the most likely to interact with U.S. Caribbean fisheries. A description of these species is included below.

3.2.2.1 ESA-Listed Sea Turtles

Green, hawksbill, leatherback, and loggerhead sea turtles are all highly migratory and travel widely throughout the U.S. Caribbean Exclusive Economic Zone (EEZ). The following sections are a brief overview of the general life history characteristics of the sea turtles found in the Caribbean EEZ. Several volumes exist that cover the biology and ecology of these species more thoroughly (i.e., Lutz and Musick (eds.) 1997, Lutz et al. (eds.) 2002).

Green sea turtle hatchlings are thought to occupy the open ocean (the "pelagic stage") and are often associated with *Sargassum* rafts (Carr 1987, Walker 1994). Pelagic stage green sea turtles are thought to be carnivorous. Stomach samples of these animals found ctenophores and pelagic snails (Frick 1976, Hughes 1974). At approximately 20-25 cm straight carapace length, juveniles migrate from pelagic habitats to benthic foraging areas (Bjorndal 1997). As juveniles move into benthic foraging areas their diet shifts toward herbivory. They consume primarily seagrasses and algae, but are also know to eat jellyfish, salps, and sponges (Bjorndal 1980, 1997; Paredes 1969; Mortimer 1981, 1982). The diving abilities of all sea turtles species vary by their life stages. The maximum diving range of green sea turtles is estimated at 360 ft (110 m) (Frick 1976), but they are most frequently making dives of less than 65 ft (20 m) (Walker 1994). The time of these dives also varies by life stage. The maximum dive length is estimated at 66 minutes with most dives lasting from 9-23 minutes (Walker 1994).

The hawksbill sea turtle's pelagic stage lasts from the time they leave the nesting beach as hatchlings until they are approximately 22-25 cm in straight carapace length (Meylan 1988, Meylan and Donnelly 1999). The pelagic stage is followed by juveniles migrating to foraging areas where juveniles reside and grow in coastal waters. Little is known about the diet of pelagic stage hawksbills. Adult foraging typically occurs over coral reefs, although other hardbottom communities and mangrove-fringed areas are occupied occasionally. Hawksbills show fidelity to their foraging areas over several years (Van Dam and Diéz 1998). The hawksbill's diet is highly specialized and consists primarily of sponges (Meylan 1988).

Gravid females have been noted ingesting coralline substrate (Meylan 1984) and calcareous algae (Anderes Alvarez and Uchida 1994), which are believed to be possible sources of calcium to aid in eggshell production. The maximum diving depths of these animals are not known, but the maximum length of dives is estimated at 73.5 minutes. More routinely, dives last about 56 minutes (Hughes 1974).

Leatherback sea turtles are the most pelagic of all ESA-listed sea turtles and spend most of their time in the open ocean; however, are seen over the continental shelf and they will enter coastal waters on a seasonal basis to feed in areas where jellyfish are concentrated. Leatherbacks feed primarily on cnidarians (medusae, siphonophores) and tunicates. Unlike other sea turtles, leatherbacks' diets do not shift during their life cycles. Because leatherbacks' ability to capture and eat jellyfish is not constrained by size or age, they continue to feed on these species regardless of life stage (Bjorndal 1997). Leatherbacks are the deepest diving of all sea turtles. It is estimated that these species can dive in excess of 1,000 m (Eckert et al. 1989) but more frequently dive to depths of 50-84 m (Eckert et al. 1986). Dive times range from a maximum of 37 minutes to more routines dives of 4-14.5 minutes (Standora et al. 1984, Eckert et al. 1986, Eckert et al. 1989, Keinath and Musick 1993). Leatherbacks may spend 74%-91% of their time submerged (Standora et al. 1984).

Loggerhead sea turtles are less common in the Caribbean region than in the Gulf of Mexico or South Atlantic regions. Loggerhead hatchlings forage in the open ocean and are often associated with *Sargassum* rafts (Hughes 1974, Carr 1987, Walker 1994, Bolten and Balazs 1995). The pelagic stage of these sea turtles are known to eat a wide range of things including salps, jellyfish, amphipods, crabs, syngnathid fish, squid, and pelagic snails (Brongersma 1972). Stranding records indicate that when pelagic immature loggerheads reach 40-60 cm straight carapace length they begin to live in coastal inshore and nearshore waters (Witzell 2002). Here they forage over hard- and soft-bottom habitats (Carr 1986). Benthic foraging loggerheads eat a variety of invertebrates with crabs and mollusks being an important prey source (Burke et al. 1993). Estimates of the maximum diving depths of loggerheads range from 211-233 m (692-764ft.) (Thayer et al. 1984, Limpus and Nichols 1988). The lengths of loggerhead dives are frequently between 17 and 30 minutes (Thayer et al. 1984, Limpus and Nichols 1988, Limpus and Nichols 1994, Lanyan et al. 1989) and they may spend anywhere from 80%-94% of their time submerged (Limpus and Nichols 1994, Lanyan et al. 1989).

3.2.2.2 ESA-Listed Marine Invertebrates

Elkhorn (*Acropora palmata)* and staghorn (*A. cervicornis*) coral ("*Acropora*") were listed as threatened under the ESA on May 9, 2006. The Atlantic *Acropora* Status Review (*Acropora* Biological Review Team 2005) presents a summary of published literature and other currently available scientific information regarding the biology and status of both these species.

Acropora are two of the major reef-building corals in the wider Caribbean. Individual staghorn coral colonies can reach up to 1.5 m across but may form thickets composed of multiple colonies that are

difficult to differentiate. Elkhorn coral colonies can grow to at least 2 m in height and 4 m in diameter and can also form dense, interlocking thickets. The depth range for these species ranges from <1 m to 60 m. The optimal depth range for elkhorn is considered to be 1 to 5 m depth (Goreau and Wells 1967), while staghorn corals are found slightly deeper, 5 to 15 m (Goreau and Goreau 1973).

All Atlantic *Acropora* species (including elkhorn and staghorn coral) are considered to be environmentally sensitive, requiring relatively clear, well-circulated water (Jaap et al. 1989). Both species obtain nutrition from filter feeding on plankton and from byproducts produced by photosynthetic algae that live in their soft tissue. Optimal water temperatures for *Acropora* range from 25° to 29°C (Ghiold and Smith 1990, Williams and Bunkley-Williams 1990). Both species are almost entirely dependent upon sunlight for nourishment, contrasting the massive, boulder-shaped species in the region (Porter 1976, Lewis 1977) that are more dependent on zooplankton. Thus, Atlantic *Acropora* species are much more susceptible to increases in water turbidity than some other coral species.

Elkhorn and staghorn corals reproduce both sexually and asexually. Asexual reproduction occurs through fragmentation when pieces of a colony break off and re-attach to hard substrate to form a new colony. Fragmentation results in multiple colonies that are genetically identical. Both species are hermaphroditic and broadcast spawn eggs and sperm into the water column for external fertilization (Szmant 1986). However, neither species can self-fertilize, and two genetically distinct parents are required to produce viable larvae (Baums et al. 2005).

Fertilization and development of *Acropora* is exclusively external. Embryonic development culminates with the development of planktonic larvae called planulae (Bak et al. 1977, Sammarco 1980, Rylaarsdam 1983). Unlike most other coral larvae, *Acropora* planulae appear to prefer to settle on upper, exposed surfaces, rather than in dark or cryptic ones (Szmant and Miller 2006), at least in a laboratory setting. Studies of *Acropora* corals indicated that larger colonies of both species had higher fertility rates than smaller colonies (Soong and Lang 1992).

Coral reefs with varying densities of elkhorn and staghorn corals are present in Puerto Rico off all coasts of the main island and around some of its smaller islands. Where surveys have been conducted, dense, high profile thickets of elkhorn and staghorn corals are present in only a few reefs along the southwest, north, and west shore of the main island and isolated offshore locations (Schärer et al. 2009b, Weil et al. unpublished data, Hernandez unpublished data). Large stands of dead elkhorn also exist on the fringing coral reefs along the shoreline (e.g., Punta Picúa, Punta Miquillo, Río Grande, Guánica, La Parguera, and Mayagüez).

The USVI also support populations of elkhorn and some staghorn corals. Elkhorn and staghorn corals are present around most of St. Croix, and elkhorn colony density in Buck Island National Monument is higher in the northern and eastern areas around the island (Mayor et al. 2006). There are limited quantitative data of presence of either species off the islands of St. Thomas; however, anecdotal reports of both

species have been reported. There are several areas around the island of St. John that support healthy populations of both elkhorn (Grober-Dunsmore et al. 2006) and staghorn corals.

3.2.3 Highly Migratory Species

Stock Status of Target Species Relevant to the Action

The thresholds used to determine the status of Atlantic highly migratory species (HMS) are fully described in Chapter 3 of the 2006 Consolidated HMS FMP, and are presented in Figure 3.2.3.1. These thresholds were incorporated into the 2006 Consolidated HMS FMP. These thresholds are based on the thresholds described in a paper providing technical guidance for implementing National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) (Restrepo et al., 1998).

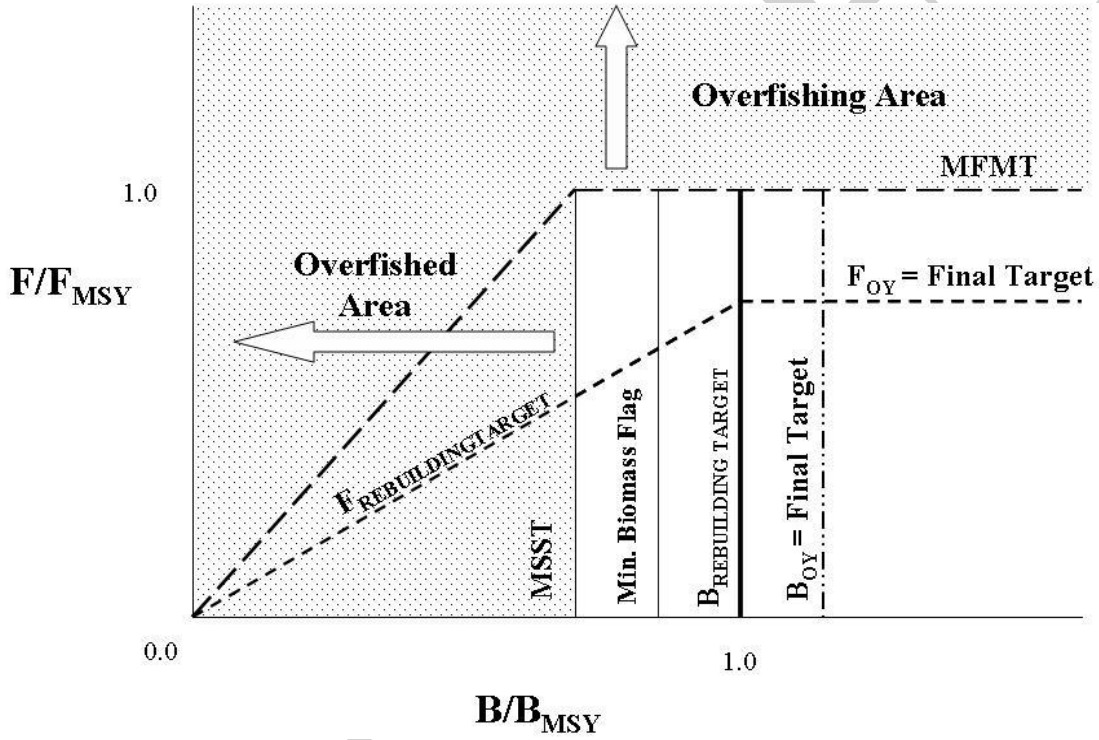


Figure 3.2.3.1 Illustration of the status determination criteria and rebuilding terms.

In summary, a species is considered overfished when the current Biomass (B) is less than the biomass at minimum stock size threshold (B_{MSST}) ($B < B_{MSST}$). The minimum stock size threshold is determined based on the natural mortality of the stock and B at maximum sustainable yield (MSY)(B_{MSY}). MSY is the maximum long-term average yield that can be produced by a stock on a continuing basis. The

biomass can be lower than B_{MSY}, and the stock not be declared overfished as long as the biomass is above B_{MSST}.

Overfishing may be occurring on a species if the current fishing mortality (F) is greater than the fishing mortality at MSY (F_{MSY}) ($F > F_{MSY}$). In the case of F, the maximum fishing mortality threshold is F_{MSY}. Thus, if F exceeds F_{MSY}, the stock is experiencing overfishing. If a species is declared overfished or has overfishing occurring, action to rebuild the stock and/or prevent further overfishing is required by law. A species is considered rebuilt when B is equal to or greater than B_{MSY} and F is less than F_{MSY}. A species is considered healthy when B is greater than or equal to the biomass at optimum yield (OY) (B_{OY}) and F is less than or equal to the fishing mortality at OY (F_{OY}).

Atlantic BAYS Tunas and North Atlantic Swordfish

All text, figures and tables for this section are from the Standing Committee on Research and Statistics (SCRS) 2013 Report and the 2013 U.S. Report to the International Commission for the Conservation of Atlantic Tunas (ICCAT) (NMFS 2013; SCRS, 2013). Table 3.2.3.1 provides a summary of stock status for Atlantic tunas and swordfish. The outlook presented for West Atlantic sailfish in Table 3.2.3.1 is from the 2013 Atlantic HMS SAFE Report. All weights are reported as whole weights unless otherwise indicated.

Table 3.2.3.1 Stock assessment summary table for Atlantic tunas and swordfish relevant to the action. Source: SCRS, 2013.

Species	Current Relative Biomass Level	Minimum Stock Size Threshold	Current Relative Fishing Mortality Rate	Maximum Fishing Mortality Threshold	Outlook
Atlantic Bigeye Tuna	B_{10}/B_{MSY} = 1.01 (0.72-1.34)	0.6 B_{MSY} (253,578t)	F_{09}/F_{MSY} = 0.95 (0.65-1.55)	F_{MSY} = 0.17	Not overfished (Rebuilding); overfishing not occurring
Atlantic Yellowfin Tuna	B_{10}/B_{MSY} = 0.85 (0.61-1.12)	0.5 B_{MSY} (age 2+)	$F_{current}/F_{MSY}$ = 0.87 (0.68-1.40)*	F_{MSY}	Not overfished; overfishing not occurring
North Atlantic Albacore Tuna	$SSB_{current}/SSB_{MSY}$ = 0.94 (0.74-1.14)**	.07 B_{MSY} (56,777t) based on SSB_{MSY})	$F_{current}/F_{MSY}$ = 0.72 (0.55-0.89)	F_{MSY} = 0.1486	Overfished; overfishing not occurring
West Atlantic Skipjack Tuna	B_{08}/B_{MSY}: most likely>1	*Unkown*	F_{08}/F_{MSY}: most likely <1	F_{MSY}	Unknown
North Atlantic Swordfish	B_{11}/B_{MSY} = 1.14 (1.05-1.24)	0.8 B_{MSY}; (B_{MSY} = 65,060t)	F_{11}/F_{MSY} = 0.82 (0.73-0.91)	F_{MSY} = 0.21 (0.17-0.26)	Not overfished; overfishing not occurring
Atlantic Blue Marlin	B_{09}/B_{MSY} = 0.67 (0.53-0.81)	0.9 B_{MSY}; (22,870t based on SSB_{MSY})**	F_{09}/F_{MSY} = 1.63 (1.11-2.16)	F_{MSY} = 0.07 (0.17-0.26)	Overfished; overfishing is occurring
Atlantic White Marlin (& Roundscale Spearfish)	B_{10}/B_{MSY} = 0.5 (0.42-0.60)	0.85 B_{MSY} (23,171-26,112t)	F_{10}/F_{MSY} = 0.99 (0.75-1.27; low productivity) F_{10}/F_{MSY} = 0.72 (0.51-0.93; high productivity)	F_{MSY} = 0.03 (0.027-0.026)	Overfished; overfishing may not be occurring
West Atlantic Sailfish	$B_{07} < B_{MSY}$; Possibly	Unknown	0.78 B_{MSY} (Unknown)	$F_{07} > B_{MSY}$; Possibly	Overfished; Overfishing is occurring***

*Fcurrent refers to F2010 in the case of ASPIC, and the geometric mean of F across 2003 - 2006 in the case of VPA.

** For North Atlantic Albacore Tuna and Blue Marlin, spawning stock biomass (SSB) is used as a proxy for biomass

*** From 2013 Atlantic HMS SAFE Report

Atlantic Bigeye Tuna

A summary of the status of bigeye tuna is found in

Table 3.2.3.1.

The 2010 stock assessment was conducted using similar assessment models to those used in 2007, but with updated data and a few new relative abundance indices and data. In general, data availability has continued to improve, notably with the addition of relative abundance indices for an increasing number of fleets. There are still missing data on detailed fishing and fish size from certain fleets. In addition, there are a number of data gaps on the activities of illegal unregulated and unreported (IUU) fleets (*e.g.*, size, location and total catch). All these problems forced the SCRS to assume catch-at-size for an important part of the overall catch.

Three types of indices of abundance were used in the assessment. A number of indices were directly developed by national scientists for selected fleets for which data was available at greater spatial and or temporal resolution to that available in the Commission databases. These indices represented data for seven different fleets, all of them longline fleets, except for one baitboat fleet. Other indices were estimated by the committee from data available within the Commission databases. These two types of indices were used for age-structured assessment models. Finally, a series of combined indices were calculated by the committee by synthesizing the information existing in individual indices for the seven fleets mentioned above. The later were used to fit production models.

Consistent with previous assessments of Atlantic bigeye tuna, the results from non-equilibrium production models are used to provide the basic characterization of the status of the resource. Results were sensitive to the combined abundance index trends assumed. As the relative likelihoods of each trend could not be estimated, results were developed from the joint distribution of model run results using each of three alternative combined indices. The plausible range of MSY estimated from the joint distribution using three types of abundance indices was between 78,700 and 101,600 tons (t) (80% confidence limits) with a median MSY of 92,000 t. In addition, these estimates reflect the current relative mixture of fisheries that capture small or large bigeye tuna; MSY can change considerably with changes in the relative fishing effort exerted by surface and longline fisheries. Historical estimates show large declines in biomass and increases in fishing mortality, especially in the mid-1990s when fishing mortality exceeded F_{MSY} for several years. In the last five or six years there have been possible increases in biomass and declines in fishing mortality. The biomass at the beginning of 2010 was estimated to be at between 0.72 and 1.34 (80% confidence limits) of the biomass at MSY, with a median value of 1.01 and the 2009 fishing mortality rate was estimated to be between 0.65-1.55 (80% confidence limits) with a median of 0.95. The replacement yield for the year 2011 was estimated to be about MSY.

The SCRS noted, as it did in previous assessments, that there is considerable uncertainty in the assessment of stock status and productivity for bigeye tuna. There are many sources of uncertainty including which method represents best the dynamics of the stock, which method is supported more by the available data, which relative abundance indices are appropriate to be used in the assessment, and what precision is associated with the measurement/calculation of each of the model inputs. In general,

data availability has improved since 2007, but there is still a lack of information regarding detailed fishing effort and catch-at-size data from certain fleets. This, combined with the lack of detailed historical information on catch and fishing activities of IUU fleets (*e.g.*, size, location and total catch), forced the SCRS to make many assumptions about the catch-at-size for an important part of the overall catch. In order to represent this uncertainty, the SCRS decided to combine sensitivity runs from a range of method/data combinations. There are differences in the estimates of management benchmarks, including the estimates of the current biomass and fishing mortality, depending on both the method used as well as the input data used.

The modeled probabilities of the stock being maintained at levels consistent with the Convention Objective (MSY) over the next five years are about 60% for a future constant catch of 85,000 t. Higher odds of rebuilding to and maintaining the stock at levels that could produce MSY are associated with lower catches and lower odds of success with higher catches than such constant catch. It needs to be noted that projections made by the SCRS assume that future constant catches represent the total removals from the stock, and not just the total allowable catch (TAC) of 85,000 t established by the Commission [Rec. 09-01]. Catches made by other fleets not affected by [Rec. 09-01] need to be added to the 85,000 t for comparisons with the future constant catch scenarios. Furthermore, any future changes in selectivity due to changes in the ratios of relative mortality exerted by the different fleets - such as an increase in the relative mortality of small fish - will change and add to the uncertainty of these projections.

<u>North Atlantic Albacore Tuna</u>

A summary of the status of northern albacore tuna is found in

Table 3.2.3.1.

A thorough revision of North Atlantic Task I and Task II data was conducted and catch rate analyses were i4mproved and updated with new information for the northern albacore fisheries. The base case assessment during the 2013 assessment session was based on similar methods and assumptions as in the previous assessment conducted in 2009. However, this time, a wider range of assessment methods were considered in sensitivity runs, including some that do not assume that catch-at-age is perfectly known. The approach provided the opportunity to evaluate a range of biological assumptions and hypothesis about how the fisheries operated over time and their impact on the population. The results of these efforts are reflected in the following summaries of stock status that analyzed data through 2011.

The catch per unit effort (CPUE) trends for the various surface fleets, based upon the most recent available data showed somewhat different patterns from each other. This was also the case for the different longline fleets. The Spanish troll CPUE series showed a rather flat trend compared to the Spanish baitboat series that showed a more upward trend in the last three decades. For the longline fleets, the general trend in CPUE indices is a decline over time up until the mid-1980s, with varying rates, with some stability afterwards and a slight increase in the last few years. Comparatively, the Japanese CPUE showed steeper declines at the beginning of the series and the Chinese Taipei series showed steeper increasing trends during the last years. Given the variability associated with these catch rate estimates, definitive conclusions about recent trends could not be reached just by examining the CPUE trends alone. The data sets used for the analyses from 1930 to 2011 were compiled and screened during the April 2013 data preparatory meeting. The basic input data, catch, effort and catch-at-size were revised due to updates in the ICCAT Task I and Task II database, and the indices to be used in assessments were specified. The definition of the fisheries was also revised and 12 fishery units were agreed for the base case Multifan-CL assessment (compared to 10 fishery units used in the last assessment). In general, the base case included similar but not exactly the same model specifications and datasets used in 2009. Decisions on the final specifications of the base case model were guided by first principles (e.g. knowledge of the fisheries) and diagnostics (e.g. goodness of fit of the model to the data).

There is substantial uncertainty on current stock status, since different models and assumptions provide a wide range of B/B_{MSY} and F/F_{MSY} estimates. However, most of them agreed on the view that spawning stock biomass decreased since the 1930s and started to recover since the mid-1990s. Most of the model formulations, as well as the base case, concluded that currently the stock is not undergoing overfishing but the spawning stock biomass is overfished. According to the base case assessment which considers catch and effort since the 1930s and size frequency since 1959, the spawning stock size has declined and in 2011 was about one third of the peak levels estimated for the late-1940s. Estimates of recruitment to the fishery, although variable, have shown generally higher levels in the 1960s and earlier periods with a declining trend thereafter.

The assessment indicated that the stock has remained overfished with spawning stock biomass (SSB) below SSB_{MSY} since the mid-1980s but has improved since the lowest levels around 30% in the late 1990s, and current SSB_{2011} is approximately 94% of SSB at MSY. Corresponding fishing mortality rates have been above F_{MSY} between the mid-1960s and the mid-2000s. Peak relative fishing mortality levels in the order of 2.5 were observed in the mid-1990 and remained below 1 afterwards, current F_{2011}/F_{MSY} ratio being 0.72. According to the base case assessment, the probability of the stock being overfished with overfishing occurring is 0.2%, of being neither overfished nor overfishing is 27.4%, and of being overfished or overfishing but not both is 72.4%. The stock projected under different scenarios indicates that if catch in the future were on average similar to those observed over the recent five years (about 20,000 t) or around the current TAC (28,000 t), the biomass would continue to increase from its level of 2012.

Atlantic Yellowfin Tuna

A summary of the status of Atlantic yellowfin tuna is found in

Table 3.2.3.1.

A full stock assessment was conducted for yellowfin tuna in 2011, applying both an age-structured model and a non-equilibrium production model to the available catch data through 2010. As has been done in previous stock assessments, stock status was evaluated using both production and age structured models. Models used were similar in structure to those used in the previous assessment; however, other alternative model structures of the production model and the VPA were explored in sensitivity runs. These runs confirmed that some of the estimated benchmarks obtained from production models are somewhat sensitive to the assumption used that MSY is obtained at half of the virgin biomass. This assumption was used in the production models that contributed to benchmark estimates found in the SCRS report.

The estimate of MSY (~144,600 t) may be below what was achieved in past decades because overall selectivity has shifted to smaller fish; the impact of this change in selectivity on estimates of MSY is clearly seen in the results from age structured models. Bootstrapped estimates of the current status of yellowfin tuna based on each model reflect the variability of the point estimates given assumptions about uncertainty in the inputs. When the uncertainty around the point estimates from both models is taken into account, there was only an estimated 26% chance that the stock was not overfished and overfishing was not occurring in 2010.

In summary, 2010 catches are estimated to be well below MSY levels, stock biomass is estimated to most likely be about 15% below the Convention Objective and fishing mortality rates most likely about 13% below F_{MSY}. The recent trends through 2010 are uncertain, with the age-structured models indicating increasing fishing mortality rates and decline in stock levels over the last several years, and the production models indicating the opposite trends.

Projections were made considering a number of constant catch scenarios, and the results from all models are summarized to produce estimated probabilities of achieving Commission objective ($B>B_{MSY}$, $F<F_{MSY}$), for a given level of constant catch, for each year up to 2025. Maintaining current catch levels (110,000 t) is expected to lead to a biomass somewhat above B_{MSY} by 2016 with a 60% probability. Higher catch levels would have a lower probability of achieving that goal and may require a longer time frame for rebuilding.

The overall catches of yellowfin tuna estimated for 2008-2010 were about 10% or more higher than the recent low of 2007. The relative contribution of purse seine gear to the total catch has increased by about 20% since 2006, which is related to the increasing purse seine effort trend. Estimates of fishable biomass trends from production modeling indicate a slow, continued rebuilding tendency, but estimates of spawning stock and total biomass trends from the age-structured assessment indicates recent decline and corresponding increasing F. In either case, continued increasing catches are expected to slow or reverse rebuilding.

West Atlantic Skipjack Tuna

A summary of the status of west Atlantic skipjack tuna is found in

Table 3.2.3.1.

In all the oceans and consequently in all the tuna Regional Fishery Management Organizations, the traditional stock assessment models have been difficult to apply to skipjack tuna because of their particular biological and fishery characteristics (on the one hand, continuous spawning, areal variation in growth and non-directed effort, and on the other, weak identified cohorts). In order to overcome these difficulties, several different assessment methods which accommodate expert opinion and prior knowledge of the fishery and biological characteristics of skipjack tuna have been carried out on the two stocks of Atlantic skipjack tuna. Several fishery indictors were also analyzed to carry out a follow up of the development in the state of the stock over time.

Although the fisheries operating in the east have extended towards the west beyond 30^{o}W longitude, the SCRS decided to maintain the hypothesis in favor of two distinct stock units, based on available scientific studies. However, taking into account the state of current knowledge of skipjack tuna migrations and the geographic distances between the various fishing areas, the use of smaller stock units continues to be the envisaged working hypothesis.

Using the reference points calculated by the current base case assessment model done in 2009, projections indicate that constant catches above 28,000 t will not result in stock rebuilding to Commission convention standards by 2020. Since 2008, catches have been lower than 28,000 t.

Western stock
The standardized CPUEs of Brazilian baitboats remain stable while that of Venezuelan purse seiners and USA rod and reel decreased in recent years. This decrease, also observed in the CPUE time series for Venezuelan purse seine fisheries, could be linked to specific environmental conditions (high surface temperatures, lesser accessibility of prey). The average weight of skipjack tuna caught in the western Atlantic is higher than in the east (3 to 4.5 kg vs. 2 to 2.5 kg), at least for the Brazilian baitboat fishery.

The assessment model from catches estimated MSY at around 30,000 t (similar to the estimate provided by the Grainger and Garcia approach) and the Bayesian surplus model (Schaefer formulation) at 34,000 t.

The Group attempted several sensitivity analyses for values of natural mortality with Multifan-CL. For this stock only the three fisheries mentioned above were considered. The final estimate of MSY converges also at about: 31,000-36,000 t. It must be stressed that all of these analyses correspond to the current geographic coverage of this fishery (*i.e.*, relatively coastal fishing grounds due to the deepening of the thermocline and of the oxycline to the East).

For the western Atlantic stock, in the light of the information provided by the trajectories of B/B_{MSY} and F/F_{MSY}, it is unlikely that the current catch is larger than the current replacement yield.

North Atlantic Swordfish

A summary of the status of north Atlantic swordfish is found in

Table 3.2.3.1.

The status of the North and South Atlantic swordfish stocks was assessed in September 2013, by means of applying statistical modeling to the available data up to 2011. Two stock assessment platforms were used to provide estimates of stock status for the North Atlantic swordfish stock, non-equilibrium surplus production model (ASPIC) and Bayesian Surplus Production Model (BSP2).

Results from the North Atlantic base case ASPIC model showed a consistent increase in estimated relative biomass since 1997. The bias corrected deterministic outcome indicates that the stock is at or above B_{MSY}. The relative trend in fishing mortality shows that the level of fishing peaked in 1995, followed by a decrease until 2001, followed by small increase in the 2002-2005 period and a downward trend since then. Fishing mortality has been below F_{MSY} since 2000. The estimate of stock status in 2011 is relatively similar to the estimated status in the 2009 assessment, and suggests that there is greater than 90% probability that the stock is at or above B_{MSY}.

The most recent estimate of stock productivity is very consistent with previous estimates. The absolute biomass trajectory showed a consistent upturn from the estimated 1997 value, and the biomass values for the most recent years are near the level estimated in the mid-1980s. The high value in 1963 is not well fit as in prior evaluations. Trends in both fishing mortality and biomass are consistent with those produced by the BSP2 model, with the latter model estimating larger stock biomass and lower fishing mortality across the entire time series. Estimates of stock status from the BSP2 model are consistent with ASPIC results.

The stock is considered rebuilt, consistent with the 2009 evaluation. Compared with the 2009 ASPIC base case model, the trajectory of biomass and F ratios are similar until the late 1990s, thereafter the current model predicted slightly lower fishing mortality rates and higher relative biomass, but certainly within the estimated 80% confidence bounds. Results from the 2013 assessment indicated that there is greater than 90% probability that the northern swordfish stock has rebuilt to or above BMSY, therefore the rebuilding plan goal has been achieved.

Atlantic Blue Marlin

A summary of the status of Atlantic blue marlin is found in

Table 3.2.3.1.

The last assessment of blue marlin was conducted in 2011. During the 2011 assessment it was noted that catches continued to decline through 2009. Over the last 20 years, Antillean artisanal fleets have increased the use of Moored Fish Aggregating Devices (MFADs) to capture pelagic fish. Catches of blue marlin caught around MFADs are known to be significant and increasing in some areas, however reports to ICCAT on these catches are incomplete. Even though catches from the Antillean artisanal fleets were included in the stock assessment, additional documentation of past and present Task I catches from these fisheries is required. Recent reports from purse seine fleets in West Africa suggest that blue marlin is more commonly caught with tuna schools associated with FADs than with free tuna schools.

During the 2011 assessment, an estimated standardized combined CPUE index for blue marlin showed a sharp decline during the period 1960-1975, followed by a period of stabilization from about 1976 to 1995, and further decline thereafter to the lowest value in the series. The results of the 2011 assessment indicated that the stock remains overfished and undergoing overfishing. In contrast to the results of the 2006 assessment, which indicated that, the declining trend in biomass had partially stabilized; current results indicate a continued declining trend. However, there is high uncertainty with regards to data and the productivity of the stock.

Although uncertain, the results of the 2011 stock assessment indicated that if the recent catch levels of blue marlin are not substantially reduced, the stock will continue to decline further. The current management plan has the potential of recovering the blue marlin stock to the B_{MSY} level, if properly conducted.

<u>Atlantic White Marlin & Roundscale Spearfish</u>
A summary of the status of Atlantic white marlin/roundscale spearfish is found in

Table 3.2.3.1.

The last assessment of white marlin was conducted in 2012. It has now been confirmed that white marlin landings reported to ICCAT include roundscale spearfish in significant numbers, so that historical statistics of white marlin most likely comprise a mixture of the two species. Studies of white marlin/roundscale spearfish ratios in the western Atlantic have been conducted, with overall estimated ratios between 23-27%, although they varied in time and space. Previously, these were thought to represent only white marlin.

A series of indices of abundance for white marlin were presented and discussed during the 2012 assessment. Following the guidelines developed by ICCAT's Working Group on Stock Assessment Methods, seven CPUE series were selected for inclusion in the assessment models. In general, the indices showed no discerning trend during the latter part of the time series examined. During the 2012 assessment, an estimated standardized combined CPUE index for white marlin showed a sharp decline during the period 1960-1991, and a relatively stable trend thereafter.

In 2012, two models were used to estimate the status of the stock, a surplus production model (ASPIC), and a fully integrated model (SS3). The methods used for the fully integrated model followed very closely to those used in the 2011 blue marlin assessment. As recommended by the Working Group in 2010, the model configuration was an effort to use all available data on white marlin, including lengths, dimorphic growth patterns and other biological data. Although it is believed that the modeling methods employed were relatively robust, the input data for the models were very likely less so. Perhaps the most important uncertainty was that associated with the landings data. There remains uncertainty not only in the species composition, but also the magnitude of the catch. This is especially problematic with the landings data starting in 2002 when reporting nations were mandated to release billfish that were alive at haulback. This led to a decrease in reported landings, but not necessarily a decrease in fishing and/or release mortality. This apparent drop in landings led to a marked decrease in the estimates of F/F_{MSY} from 2002-present, however the Committee considers that this trend is likely overly optimistic due to unreported catch and unaccounted release mortality.

The results of the 2012 assessment indicate that the stock remains overfished, but most likely is not undergoing overfishing. Relative fishing mortality has been declining over the last ten years and is now most likely to be below F_{MSY}. Relative biomass has probably stopped declining over the last ten years, but still remains well below B_{MSY}. There is considerable uncertainty in these results. The two assessment models provide different estimates about the productivity of the stock, with the integrated model suggesting that white marlin is a stock that can rebuild relatively fast whereas the surplus production model suggests the stock will rebuild very slowly. The results from both approaches are considered to be equally plausible. These results are conditional on the reported catch being a true reflection of the fishing mortality experienced by white marlin. Sensitivity analyses suggest that if recent fishing mortality has been greater than reported (because discards are not reported by many fleets), estimates of stock status

would be more pessimistic and current relative biomass would be lower and overfishing would continue. The presence of unknown quantities of roundscale spearfish in the reported catches and data used to estimate relative abundance of white marlin increases the uncertainty for the stock status and outlook for this species.

Western Atlantic Sailfish

A summary of the status of western Atlantic sailfish is found in

Table 3.2.3.1.

The first successful assessment that estimated reference points for eastern and western sailfish stocks was conducted in 2009. ICCAT recognizes the presence of two stocks of sailfish in the Atlantic, the eastern and western stocks. There is increasing evidence that an alternative stock structure with a north western stock and a south/eastern stock should also be considered. Assessments of stocks based on the alternative stock structure option have not yet been conducted. In 2009, ICCAT conducted a full assessment of both Atlantic sailfish stocks through a range of production models and by using different combinations of relative abundance indices. There remains considerable uncertainty regarding the status of the two sailfish stocks, however, many assessment model results present evidence of overfishing and evidence that the stocks are overfished, more so in the east than in the west. Although some of the results suggest a healthy stock in the west, few suggest the same for the east.

Examinations of recent trends in abundance suggest that both the eastern and western stocks suffered their greatest declines in abundance prior to 1990. Since 1990, trends in relative abundance conflict between different indices, with some indices suggesting declines, other increases, and others showing no trend. Examination of available length frequencies for a range of fleets show that average length and length distributions do not show clear trends during the period where there are observations. A similar result was obtained in the past for marlins. Although it is possible that, like in the case of the marlins, this reflects the fact that mean length is not a good indicator of fishing pressure for billfish it could also reflect a pattern of high fishing pressure over the period of observation.

Both the eastern and western stocks of sailfish may have been reduced to stock sizes below BMSY. There is considerable uncertainty on the level of reduction, particularly for the west, as various production model fits indicated the biomass ratio B2007/BMSY both above and below 1.0.

Atlantic Sharks of the Caribbean Region

This section briefly discusses the stock status of the Atlantic shark species/complexes that the action would affect based on their ecology and geographical range (shark species in the large coastal shark complex, specifically tiger, blacktip, lemon, nurse and great hammerhead sharks; the small coastal shark complex, specifically bonnetheads, Atlantic sharpnose, finetooth, and blacknose sharks; pelagic shark species, specifically blue, common thresher, and oceanic whitetip sharks; and prohibited sharks species, specifically Caribbean sharpnose, smalltail, Caribbean reef, and bigeye thresher sharks). With the exception of blue, shortfin mako, and porbeagle sharks, which are assessed by the ICCAT's Standing Committee on Research and Statistics (SCRS), large and small coastal Atlantic sharks stock assessments are conducted through the NMFS Southeast Data, Assessment, and Review (SEDAR) process.

Not all shark species found in the Caribbean region have been assessed due to lack of reliable catch data and insufficient information regarding appropriate estimates for needed life history parameters. Those that have been assessed are shown below in Table 3.2.3.2 and their assessments are described in more detail below. For more information regarding management and status of Atlantic shark species managed by NMFS, please see Section 2.0 of the 2013 SAFE Report (NMFS 2013). All SCRS final stock assessments reports can be found at www.iccat.int/. All SEDAR assessments can be found at http://www.sefsc.noaa.gov/sedar/.

Table 3.2.3.2 summarizes stock assessment information and the current status of Atlantic shark species in the Caribbean region as of March 2013.

Table 3.2.3.2 Stock assessment summary table for Atlantic sharks in the Caribbean region. Sources: SCRS, 2008; NMFS 2007; SEDAR 2011, 2012a, 2013a, 2013b.

Species	Current Relative Biomass Level	B_{MSY}	Minimum Stock Size Threshold	Current Relative Fishing Mortality Rate	Maximum Fishing Mortality Threshold	Outlook
Gulf of Mexico Blacktip	SSF_{2010}/SSF_{MSY} = 2.00-2.66	SSF_{MSY} = 1,570,000 - 6,440,000 (numbers of sharks)	1,327,697 - 5,446,093 (1-M)*SSF_{MSY}	F_{2010}/F_{MSY} = 0.05–0.27	0.021-0.163	Not overfished; overfishing not occurring
Atlantic Blacktip	*Unknown*	*Unknown*	1-M B_{msy}	*Unknown*	*Unknown*	*Unknown*
Bonnethead Sharks‡	*Unknown*	*Unknown*	*Unknown*	*Unknown*	*Unknown*	*Unknown*
Atlantic Sharpnose Sharks‡	SSF_{2011}/SSF_{MSY} =0.53 – 3.75	SSF_{MSY} = 4,860,000 – 165,000,000 (numbers of sharks)	3,732,480 – 126,720,000 (1-M) SSF_{MSY}	F_{2011}/F_{MSY} = 0.03 – 1.06	0.18 – 0.43	Not overfished; overfishing not occurring
Atlantic Blacknose Sharks	SSF_{09}/SSF_{MSY} = 0.43 – 0.64	SSF_{MSY} = 77,577-288,360 (numbers of sharks)	62,294-231,553 (based on SSF_{MSY})	F_{09}/F_{MSY} = 3.26 – 22.53	0.01-0.15	Overfished; overfishing is occurring
Gulf of Mexico Blacknose Sharks	*Unknown*	*Unknown*	(1-M) B_{MSY}	*Unknown*	*Unknown*	*Unknown*
Finetooth Sharks	N_{05}/N_{MSY} = 1.80	N_{MSY} = 3,200,000 (numbers of sharks)	2,400,000 (based on N_{MSY})	F_{05}/F_{MSY} = 0.17	0.03	Not overfished; overfishing not occurring
Blue Sharks	B_{07}/B_{MSY} = 1.87-2.74	*Unknown*	1-M B_{msy}	F_{07}/F_{MSY} = 0.13-0.17	0.15	Not overfished; overfishing not occurring

‡ The results indicated here are preliminary and are based on the assessment conducted in 2013 and delivered, with a peer review, to the agency in November 2013. At the time of writing this document, NMFS was reviewing the results of that assessment and its review and had not yet made any determination on whether to accept the assessment.

‡ SSF= spawning stock fecundity

Large Coastal Sharks

Blacktip Sharks

The 2005/2006 stock assessment assessed blacktip sharks for the first time as two separate populations: a Gulf of Mexico and an Atlantic population (NMFS 2006). The results indicate that the Gulf of Mexico stock is not overfished and overfishing is not taking place (November 7, 2006, 71 FR 65086), but the assessment panel did not accept the absolute estimates of the stock status. The three abundance indices believed to be most representative of the stock were consistent with each other, suggesting that stock abundance has been increasing over a period of declining catch during the past 10 years. Based on life history characteristics, blacktip sharks are a relatively productive shark species, and a combination of these characteristics and recent increases in the most representative abundance indices, suggested that the blacktip stock is relatively healthy. There was no scientific basis, however, for NMFS to consider increasing the catch or quota.

This assessment also indicated that the current status of the blacktip shark population in the Atlantic region was unknown. The assessment scientists were unable to provide estimates of stock status or reliable population projections, but indicated that current catch levels should not change. Based on this, NMFS declared the status of the Atlantic blacktip shark population to be unknown (November 7, 2006, 71 FR 65086).

Gulf of Mexico blacktip sharks were recently assessed in 2012 under the SEDAR process (SEDAR, 2012a). This latest assessment assessed only blacktip sharks in the Gulf of Mexico due to timing and personnel limitations. The base model used for the SEDAR 29 assessment showed that Gulf of Mexico blacktip sharks were not overfished (SSF_{2010}/SSF_{MSY}=2.00-2.78) and no overfishing was occurring (F_{2010}/F_{MSY}=0.05-0.27). The assessment was peer reviewed and based on this review and follow up by the assessment scientists, NMFS made the determination that the Gulf of Mexico blacktip shark stock is not overfished and no overfishing is occurring (77 FR 70552, November 26, 2012).

Small Coastal Sharks

Almost all small coastal shark species, as defined in the 1993 Shark FMP, can be found in the U.S. Caribbean Region. These species include Atlantic sharpnose (can only be distinguished from the Caribbean sharpnose on the basis of vertebral counts), the Caribbean sharpnose, blacknose, bonnethead, finetooth, and smalltail sharks. In 1999, NMFS added Caribbean sharpnose, and smalltail sharks to the prohibited species list (64 FR 29090, May 28, 1999). To date, none of the prohibited shark species found in the Caribbean region have been assessed.

Atlantic Sharpnose

The 2007 assessment for Atlantic sharpnose sharks also indicated that the stock is not overfished (SSF_{2005}/SSF_{MSY} = 1.47) and that no overfishing is occurring (F_{2005} / F_{MSY} = 0.74) (NMFS 2007).

However, because estimates of fishing mortality from the assessment indicated that fishing mortality was close to, but below, F_{MSY} (*i.e.*, overfishing is not occurring), the peer reviewers suggest setting a threshold for fishing mortality to keep it below the F_{MSY} threshold to prevent overfishing in the future. Based on these results, NMFS determined that Atlantic sharpnose sharks were not overfished with no overfishing occurring (73 FR 25665, May 7, 2008).

The most recent assessment for Atlantic sharpnose sharks was conducted in 2013 following the SEDAR process (SEDAR 2013a). The assessment scientists used a state-space, age-structured production model (SSASPM) as in the previous assessment (SEDAR 13 conducted in 2007). The peer reviewed 2013 assessment provided an update to the 2007 assessment. In addition, it provided estimates of shrimp trawl discards using stratified nominal estimates of bycatch instead of model-generated estimates. Other changes with respect to the previous assessment included using recreational Marine Recreational Information Program (MRIP) estimates instead of Marine Recreational Fisheries Statistics Survey (MRFSS), adding post-release live discard mortality estimates for the recreational and the three commercial catch series, and adding dead discard estimates in the bottom longline commercial catch series. The assessment indicated that the stock was not overfished (SSF_{2011}/SSF_{MSY} =0.53 – 3.75) and overfishing was not occurring (F_{2011}/F_{MSY} = 0.03 – 1.06) in 2011. However, the results shown in Table 3.2.3.2 are preliminary and are based on the assessment conducted in 2013 and delivered, with a peer review, to the agency in November 2013. At the time of writing this document, NMFS was reviewing the results of that assessment and its review, and the Agency has not yet made any stock status determinations nor decided whether or not to accept the assessment.

Bonnethead Sharks

The 2007 bonnethead stock assessment used a state-space, age structured model as the base model to assess bonnethead sharks (NMFS 2007). Based on the 2007 bonnethead stock assessment, the peer reviewers determined that bonnethead sharks were not overfished (SSF_{2005}/SSF_{MSY} = 1.13) and overfishing was not occurring (F_{2005}/F_{MSY} = 0.61). However, fishing mortality rates in the past had fluctuated above and below F_{MSY}. Thus, the peer reviewers said that there was some probability that fishing mortality rates in 2006 and 2007 were in excess of F_{MSY}. Given this, projections showed that if the average F from the past 10 years was maintained, there was some probability that spawning stock fecundity (SSF) would fall below SSF_{MSY}, in the future, if the current average F's were maintained (*i.e.*, bonnethead sharks would then become overfished). Thus, NMFS should be cautious when developing new management measures for overfished species so as to not increase fishing pressure on bonnethead sharks. However, since the 2005 estimate of SSF was above SSF_{MSY} and the 2005 estimate of F was below F_{MSY}, NMFS determined that bonnethead sharks were not overfished with no overfishing occurring (73 FR 25665, May 7, 2008).

The most recent assessment for bonnethead sharks was conducted in 2013 following the SEDAR process (SEDAR 2013b). The assessment scientists used a state-space, age-structured production model (SSASPM) as in the previous assessment (SEDAR 13 conducted in 2007). The peer reviewed 2013

assessment provided an update to the 2007 assessment and assessed the bonnethead sharks as one stock, despite evidence of two separate stocks. In addition, the 2013 assessment provided estimates of shrimp trawl discards using stratified nominal estimates of bycatch instead of model-generated estimates. Other changes with respect to the previous assessment included using recreational MRIP estimates instead of MRFSS, adding post-release live discard mortality estimates for the recreational and the three commercial catch series, and adding dead discard estimates in the bottom longline commercial catch series. At this time, there is no stock status outlook for bonnethead sharks as the assessment panel stressed that there is strong evidence for two separate stocks and strongly recommended that a benchmark assessment for two separate stocks of bonnethead shark be undertaken as soon as possible. As with Atlantic sharpnose, the results shown in Table 3.2.3.2 are preliminary and are based on the assessment conducted in 2013 and delivered, with a peer review, to the agency in November 2013. At the time of writing this document, NMFS was reviewing the results of that assessment and its review, and the Agency has not yet made any stock status determinations nor decided whether or not to accept the assessment.

Blacknose Sharks

Based on the 2007 assessment for blacknose shark (NMFS 2007) NMFS determined that blacknose sharks were overfished and experiencing overfishing (May 7, 2008, 73 FR 25665). The assessment indicated that a constant TAC of 19,200 individuals would have led to rebuilding with 70% probability by 2027.

Blacknose sharks were recently assessed again in 2011/2012 through the SEDAR process (76 FR 61092; October 3, 2011) (SEDAR 2011). This latest assessment incorporated new landings and biological information that were not available for previous assessments. Unlike the 2007 assessment, the 2011/2012 assessment assessed blacknose sharks as two separate stocks (a Gulf of Mexico and an Atlantic stock) based on tagging and life history data.

For the Atlantic blacknose shark stock, the 2011/2012 assessment used an age-structured production model base model that showed that Atlantic blacknose sharks were overfished (SSF_{2009}/SSF_{MSY}=0.60) and experiencing overfishing (F_{2009}/F_{MSY}=5.02). In addition, 14 sensitivity analyses were performed over the assessment cycle. The Review Panel selected five sensitivity runs in addition to the base model to assess the underlying states of nature of the stock. Current biomass (*i.e.*, SSF) values from these selected sensitivity runs all indicated that the stock is overfished (SSF_{2009}/SSF_{MSY}=0.43-0.64). In addition, current F values from the selected sensitivity runs indicated that the stock is currently experiencing overfishing (F_{2009}/F_{MSY}=3.26-22.53). Based on this, NMFS has determined that the Atlantic blacknose shark stock is overfished and experiencing overfishing (76 FR 62331; October 7, 2011). Projections of the base model indicated that the stock could rebuild by 2043 with a TAC of 7,300 blacknose sharks. The rebuilding year determined from the base model in the 2010/2011 assessment was calculated as the year the stock would rebuild with no fishing pressure (*i.e.*, F=0), or 2034, plus one generation time (the generation time for Atlantic blacknose sharks is 9 years). The target year for rebuilding ranged from 2033 to 2086 depending on the state of nature (*i.e.*, sensitivity run) of the stock. Thus, Atlantic blacknose sharks would not have

been able to rebuild by the current rebuilding target of 2027 under the previous fishery-wide TAC of 19,200 blacknose sharks.

The assessment model for the Gulf of Mexico stock, however, did not fit the apparent trends in some of the abundance indices and there was a fundamental lack of fit of the model to some of the input data. Therefore, the Review Panel for the 2011/2012 blacknose assessment did not accept the stock assessment for the Gulf of Mexico blacknose stock. Thus, NMFS declared the status of the Gulf of Mexico blacknose shark stock as unknown (76 FR 62331, October 7, 2011).

Finetooth Sharks

According to the 2007 finetooth shark stock assessment, finetooth sharks were not overfished (N_{2005}/N_{MSY} = 1.80) and overfishing was not occurring (F_{2005}/F_{MSY} = 0.17) (NMFS 2007). This is a change from the 2002 assessment in which finetooth sharks were determined to be experiencing overfishing. However, NMFS also notes that while the peer reviewers agreed that it is reasonable to conclude that the stock is not currently overfished, they also indicated that given the limited data available on the population dynamics for finetooth, management should be cautious. Unlike the other SCS, where the bulk of the mortality occurs in shrimp trawl gear, the majority of the mortality for finetooth sharks occur in gillnets. Given the 2007 assessment, NMFS determined that finetooth sharks are not overfished and overfishing is not occurring (May 7, 2008, 73 FR 25665)

Pelagic Sharks

Pelagic sharks are subject to exploitation by many different nations and exhibit trans-oceanic migration patterns. As a result, ICCAT's SCRS's Subcommittee on Bycatch has recommended that ICCAT take the lead in conducting stock assessments for pelagic sharks. In the beginning of 2004, the SCRS committed to conducting stock assessments for selected pelagic shark species no later than 2007, with emphasis placed on blue sharks and shortfin mako sharks. All SCRS stock assessments can be found at http://www.iccat.es/assess.htm.

2008 SCRS Shark Stock Assessments

In 2008, the SCRS conducted assessments for the stocks of blue sharks and shortfin mako sharks. The SCRS determined that while the quantity and quality of the data available for use in the stock assessment had improved since the 2004 assessment, they were still uninformative and did not provide a consistent signal to inform the models used in the 2008 assessment. The SCRS noted that if these data issues could not be resolved in the future, their ability to determine stock status for these and other species will continue to be uncertain. The SCRS assessed blue and shortfin mako sharks as three different stocks, North Atlantic, South Atlantic, and Mediterranean. However, the Mediterranean data was considered insufficient to conduct the quantitative assessments for these species. In addition, in 2008, an ecological risk assessment (ERA) was conducted by the SCRS for nine additional priority species of pelagic

elasmobranchs, for which available data are very limited. The ERA conducted by the SCRS for 11 priority species of sharks caught in ICCAT fisheries, demonstrated that most Atlantic pelagic sharks have exceptionally limited biological productivity and, as such, can be overfished even at very low levels of fishing mortality (Cortés et al. 2010). Specifically, the analyses indicated that bigeye thresher, longfin mako, and shortfin mako sharks have the highest vulnerability (and lowest biological productivity) of the shark species examined (with bigeye thresher being substantially less productive than the other species) (Cortés et al. 2010). All species considered in the ERA, particularly smooth hammerhead, longfin mako, bigeye thresher, and crocodile sharks, are in need of improved biological data to evaluate their biological productivity more accurately and thus specific research projects should be supported to that end. The SCRS recommended that ERAs be updated with improved information on the productivity and susceptibility of these species.

2012 SCRS Shark Stock Assessments

In 2012, the SCRS completed a stock assessment for shortfin mako sharks and another ERA, which included a total of 16 shark species (20 stocks). The ERA was a quantitative assessment consisting of a risk analysis to evaluate the biological productivity of these stocks and a susceptibility analysis to assess their propensity to capture and mortality in pelagic longline fisheries (Anon 2012). The five stocks with the lowest productivity were the bigeye thresher, sandbar, longfin mako, night, and South Atlantic silky shark. The highest susceptibility values corresponded to shortfin mako, North and South Atlantic blue sharks, porbeagle, and bigeye thresher sharks (Anon 2012). Based on the results, the bigeye thresher, longfin and shortfin makos, porbeagle, and night sharks were the most vulnerable stocks (Anon 2012). In contrast, North and South Atlantic scalloped hammerheads, smooth hammerhead, and North and South Atlantic pelagic stingray had the lowest vulnerabilities (Anon 2012). The SCRS observed that the data regarding night shark distribution was considered to be incomplete and preliminary (Anon 2012).

<u>Blue Sharks</u>

With regard to North and South Atlantic blue sharks, the 2008 stock assessment determined that the biomass is estimated to be above the biomass that would support MSY. Similar to the results of the 2004 assessment, in many of the model runs, stock status appeared to be close to the unfished biomass levels (B_{2007}/B_{MSY} = 1.87 - 2.74) and fishing mortality rates were well below those corresponding to the level at which MSY is reached (F_{MSY} = 0.15). Most of the models used in the assessment consistently predicted that blue shark stocks in the Atlantic were not overfished and overfishing was not occurring (SCRS 2008). Given these results, NMFS determined that blue sharks are not overfished with no overfishing occurring. The SCRS will conduct another stock assessment for blue sharks in 2015.

3.2.4 Description of Highly Migratory Species Fisheries

Commercial HMS Fisheries in Puerto Rico

In the United States, six categories of commercial Atlantic tuna permits are currently issued: Atlantic Tunas General, HMS Charter/Headboat (CHB), Atlantic Tunas Harpoon, Atlantic Tunas Purse Seine, Atlantic Tunas Longline, and Trap. The HMS CHB permit is required for for-hire vessels that target HMS. Atlantic tunas may be sold with an HMS CHB permit. The Atlantic Tunas Longline permit is valid only if the vessel owner also holds both an Atlantic swordfish and an Atlantic shark limited access fishing permit. The Atlantic Tunas General, Harpoon, and Trap permits are open access and only allow for the harvest of tunas.

As of October 2013, there were 8,027 vessel permits issued in the commercial Atlantic tuna fishery, including 3,783 Atlantic Tunas General permits; 3,968 HMS CHB permits; 252 Atlantic Tunas Longline permits; 14 Atlantic Tunas Harpoon permits; 7 Trap permits; 3 Atlantic Tunas Purse Seine permits. As shown in

Table 2.4.1, there were 83 Atlantic Tunas General category permits and 18 CHB permits issued in Puerto Rico.

The U.S. directed commercial fishery for North Atlantic swordfish is restricted to two gear types: longline and handgear. Pelagic longline gear accounts for the majority of U.S. swordfish landings; however, there is increasing effort in the commercial handgear fishery. Incidental catches by fishing gears other than pelagic longline and handgear are restricted by incidental commercial retention limits of 15 to 30 swordfish per trip, depending upon the gear type, and landings are counted against the incidental swordfish quota.

In 2013, there were 185, 71, and 81 directed, incidental, and handgear commercial swordfish limited access permits issued in the United States, respectively. However, there were no swordfish limited access fishing permits issued to residents of Puerto Rico. In March 2014, one swordfish dealer permit was issued in Puerto Rico.

Atlantic shark fisheries in the U.S. primarily deploy bottom longline, pelagic longline, and gillnet gears. The majority of small-scale commercial vessels participating in HMS fisheries in the Caribbean Region use handgear (handline, rod and reel). Prior to the implementation of Amendment 2 to the 2006 Consolidated HMS FMP in 2008, the primary target species in the commercial shark fisheries were sandbar and blacktip sharks, although many other shark species were also caught.

As of October 2013, 220 U.S. vessels were permitted to directly fish commercially for sharks and another 265 vessels had incidental shark limited access fishing permits. However, there were no shark limited access fishing permits or shark dealer permits held by residents of Puerto Rico.

In January 2013, a new permit called the Commercial Caribbean Small Boat permit became effective for fishing in U.S. Caribbean waters only. This permit allows for the commercial retention of up to 10 BAYS tunas and two swordfish per trip for boats less than 45 ft. in length overall and only when fishing in the U.S. Caribbean region. Authorized gears under this permit include rod & reel, handline, harpoon, bandit gear, green-stick, and buoy gear. This unique permit also allows for the sale of these species to persons that do not have a federal tuna or swordfish permit. As of February 2014, 18 Commercial Caribbean Small Boat permits had been issued and 2 of these permits were held by residents of Puerto Rico.

In November 2013, a new open-access swordfish permit called the Swordfish General Commercial permit became available. This permit allows for the commercial retention of up to two swordfish per trip and authorized gears under this permit include rod & reel, handline, harpoon, bandit gear, and green-stick gear. As of February 2014, 218 Swordfish General Commercial permits had been issued. Eight of these permits were held by residents of Puerto Rico.

Except for persons issued a Commercial Caribbean Small Boat permit, all HMS may only be sold to dealers issued a federal tuna, swordfish, and/or shark dealer permit.

The number of commercial HMS fishing and dealer permits issued in Puerto Rico is shown in

Table 3.2.4.1.

Table 3.2.4.1. Number of Commercial HMS permits in Puerto Rico in 2013-2014.

Permit Type	Number of Permits Issued in Puerto Rico
Atlantic Tunas General*	83
HMS CHB*	18
Swordfish General Commercial**	8
Commercial Caribbean Small Boat**	2
BAYS Tuna Dealer*	4
Bluefin/BAYS Tuna Dealer*	1
Swordfish Dealer**	1

* As of October 2013
**As of February 2014

In the U.S. Caribbean region, commercial tuna fishermen primarily use pelagic longline, rod and reel, handline, and buoy gear. Yellowfin and skipjack tuna are the predominant catch. In 2012, vessels fishing in the Caribbean landed approximately 144.7 metric tons (mt) of yellowfin tuna, 7.4 mt of skipjack tuna, 0.002 mt of bigeye tuna, and 0.0 mt of albacore tuna. Of the 152.1 mt of bigeye, albacore, yellowfin, and skipjack (BAYS) tunas landed in the U.S. Caribbean in 2012, 142.0 mt were reported as captured with pelagic longline gear (NMFS 2013). Since no Atlantic Tunas longline permits are issued to residents of Puerto Rico, it can be assumed that these tuna landings were reported by vessels fishing in the Caribbean but based out of other U.S. ports. Approximately 9.1 mt of tunas were reported as harvested with handline and rod and reel gears. The handline and rod and reel landings were likely reported by Caribbean fishermen fishing issued Atlantic Tunas General or HMS CHB permits.

In 2012, 3.9 mt of swordfish were reported as harvested from the Caribbean (NMFS 2013). Of those swordfish landings reported, 3.7 mt were reported as harvested with pelagic longline gear and likely by vessels not based in Caribbean ports. In 2012, 0.2 mt were reported as landed with handgears. In 2010 and 2011, all of the swordfish reported as commercially landed in the Caribbean were harvested with pelagic longline gear.

The limited numbers of commercial fishing permits and dealer permits in Puerto Rico has resulted in limited catch and landings data for some HMS fisheries in the region. However, territorial laws require commercial fishermen to report all landings, including HMS via fishermen catch reports. The NMFS Southeast Fishery Science Center, NMFS Office of Science and Technology, and the territorial governments have been actively working on improving U.S. Caribbean commercial and recreational HMS landing information. See Table 3.2.4.2 for Caribbean HMS landings as reported to ICCAT from 2008 – 2012.

Table 3.2.4.2. Catches and Landings of HMS in the Caribbean Reported from 2008 – 2012 in mt (NMFS, 2013).

	2008	2009	2010	2011	2012
Yellowfin Tuna					
Pelagic Longline	107.1	136.7	212.2	132.1	141.9
Trap	0	0	0	0	0
Gillnet	0.04	0.04	0	0	0
Handline	3.7	3.3	1.9	1.5	2.8
Rod and Reel*	9.7	3.5	4.5	0.9	0
Total	120.54	143.54	218.6	134.5	144.7
Skipjack Tuna					
Pelagic Longline	1.3	0.05	0	0	0.1
Trap	0	0	0	0	1
Gillnet	0.01	0.6	0	0	0
Handline	16	8.8	6.2	4.5	3.3
Rod and Reel*	11.3	4.3	0.4	3.0	3.0
Total	28.61	13.75	6.6	7.5	7.4
Bigeye Tuna					
Pelagic Longline	8.9	22.2	5.0	0	0.002
Rod and Reel*	0	0	0	2.3	0
Total	8.9	22.2	5.0	2.3	0.002

Albacore Tuna					
Pelagic Longline	0.4	0.3	0.7	0	0
Rod and Reel*	0	0	103.6	0	0
Handline	0.4	0.003	0.05	0	0
Total	0.8	0.303	104.35	0	0
Bluefin Tuna					
All Gears	0	0	0	0.6	0.9
Total	0	0	0	0.6	0.9
Swordfish					
Pelagic Longline**	57.9	22.6	41.4	14,2	3.7
Handline	0	0.003	0	0	0
Rod and Reel*	0	0	0	0	0.2
Total	57.9	22.603	41.4	14.2	3.9

*Rod and Reel catches and landings include estimates of landings and dead discards based on statistical surveys of the U.S. recreational harvesting sector

**Statistics include landings and estimated discards from scientific observer and logbook sampling programs

With regards to the location of HMS commercial longline fishing activities in the Caribbean, and west of Puerto Rico in particular, NMFS analyzed data from the HMS logbook from 2003 to 2012. Data were extracted for all sets that occurred in the ICCAT Caribbean statistical reporting area. Then, these sets were analyzed to determine sets that occurred in a smaller sub-area entitled "west of Puerto Rico," (shown below) and bounded from N. lat. 17º 40' to N. lat.18º 30' and W. long. 67º to W. long. 68º. Finally, these sets were analyzed to determine sets that occurred in Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank.

It was found that no HMS longline sets were reported to have occurred in the three areas over this ten year period (Table 3.2.4.3).

Table 3.2.4.3. Reported Number of HMS Longline Sets by Area (2003 – 2012).

YEAR	# of HMS Longline Sets in Caribbean ICCAT Statistical Area	# of HMS Longline Sets in Area West of Puerto Rico (N. lat. 17º 40' to 18º 30' and W. long. 67º to 68º)	# of HMS Longline Sets in Abrir La Sierra Bank, Bajo de Sico, & Tourmaline Bank Areas
2012	6	1	0
2011	24	1	0
2010	75	1	0
2009	43	5	0
2008	100	11	0
2007	41	0	0
2006	85	2	0
2005	198	29	0
2004	356	9	0
2003	218	11	0

In conclusion, the available data indicate that there are few HMS longline sets made in the EEZ near Puerto Rico or in Puerto Rican territorial waters, and those that have been made were deployed by vessels based in the continental U.S. For these vessels, the primary target species were yellowfin tuna, skipjack tuna, and swordfish. A smaller amount of yellowfin and skipjack tuna was harvested by commercial handgear vessels issued Atlantic Tunas General permits that were fishing out of Puerto Rican ports. It is expected that the amount of commercially-harvested tuna and swordfish by Puerto Rican handgear vessels will increase in the future due to the recent implementation of the Commercial Caribbean Small Boat permit and the Swordfish General Commercial permit.

Recreational HMS Fisheries in Puerto Rico

There are two recreational HMS fishing permits: the HMS Angling permit and the HMS CHB permit. The HMS Angling permit is required to fish recreationally for HMS and the sale of fish is prohibited under this permit. In 2013, there were 21,686 HMS Angling permits, of which 604 were issued to residences in Puerto Rico. The HMS CHB permit is required for for-hire vessels that target HMS. Atlantic tunas and swordfish (on non for-hire trips only) may be sold with an HMS CHB permit. As of October 2013, there were 3,968 HMS CHB permits, of which 18 were issued to businesses in Puerto Rico (Table 3.2.4.4).

Table 3.2.4.4. Number of Recreational HMS permits in Puerto Rico in 2013.

Permit Type	Number of Permits Issued in Puerto Rico
HMS Angling	604
HMS CHB	18

The comparatively large number of HMS Angling permits issued in Puerto Rico indicates that recreational fishing for HMS is an important activity for many residents. However, it can be difficult to quantify the magnitude of this activity due to potential gaps in recreational reporting and survey data.

All recreational, non-tournament landings of billfish, including swordfish, are required to be reported to NMFS within 24 hours of landing by the permitted owner of the vessel landing the fish. This requirement is applicable to all permit holders, both private and charter/headboat vessels, that are not fishing in a tournament. In Maryland and North Carolina, vessel owners are required to report their billfish landings at state-operated landings stations. Table 3.2.4.5 provides a summary of billfish and swordfish landings as reported by Puerto Rican recreational anglers and charter/headboat operators.

Table 3.2.4.5. Recreational Non-Tournament Landings of Billfish & Swordfish in Puerto Rico (2004 – 2013). Source. HMS Recreational Reporting Program.

	Blue Marlin	White Marlin	Sailfish	Swordfish
2013	-	-	-	-
2012	2	-	-	1
2011	-	-	-	-
2010	-	-	-	-
2009	1	-	1	-
2008	6	-	-	-
2007	2	-	-	-
2006	1	1	-	-
2005	1	-	-	-
2004	1	-	-	2

In addition to the HMS recreational non-tournament reporting program, the MRIP Program may survey anglers at the dock or by phone. If contacted, anglers are required to participate in these surveys. The MRIP surveys include all species of fish encountered on a trip, including sharks and tunas. This survey provides information on both landings and releases. Table 3.2.4.6 summarizes HMS MRIP data from 2013 from Puerto Rico, including catches, releases, and proportional standard error (PSE). A PSE greater than 50 indicates a very imprecise measurement. The high PSEs for HMS occur because catches are relatively rare events within the sampling frame of the survey.

Table 3.2.4.6. 2013 MRIP HMS Catches & Releases from Puerto Rico (in numbers of fish).

	Catches	Releases	PSE
Blue Marlin	-	1,355	82.9
White Marlin	-	-	-
Sailfish	-	-	-
Bigeye Tuna	-	-	-
Albacore Tuna	-	-	-
Yellowfin Tuna	345	-	84.4
Skipjack Tuna	126	-	99.7
Bluefin tuna	-	-	-
Swordfish	-	-	-
Sharks (all species)	-	-	-

Federal regulations require that all HMS tournament operators must register their tournaments with NMFS at least four weeks prior to the commencement of tournament fishing activities. Registration provides important fishery management information regarding recreational HMS fishing activities. An average of 17 HMS fishing tournaments have occurred annually in Puerto Rico since 2003. On the west coast of Puerto Rico, the ports of Boqueron, Cabo Rojo, Mayaguez, and Rincon have conducted an average of five HMS fishing tournaments annually. In 2013, three HMS fishing tournaments were held; one each in in Boqueron, Cabo Rojo, and Mayaguez. All three of these tournaments were held in October, 2013 (Table 3.2.4.7).

Table 3.2.4.7. HMS Tournaments Conducted on West Coast of Puerto Rico (2009 – 2013).

Tournament Name	Port	State	Start Month	Year
20TH TORNEO DE DORADO 2009	BOQUERON	PR	MAR	2009
TORNEO DE AGUJA AZUL CLUB NAUTICO BOQUERON 2009	BOQUERON	PR	SEP	2009
5TH TORNEO DE MARLIN MARINA BOQUERON 2009	BOQUERON	PR	OCT	2009
TORNEO PETO Y DORADO 2009	CABO ROJO	PR	FEB	2009
XXI INT. LIGHT TACKLE BLUE MARLIN TOURN. 2009	CABO ROJO	PR	SEP	2009
X TORNEO DAMAS AGUJA AZUL 2009	CABO ROJO	PR	SEP	2009
1ST ANNUAL CARIBBEAN CHALLENGE 2009	CABO ROJO	PR	SEP	2009
AMERICAN CARIBBEAN CHALLENGE	CABO ROJO	PR	SEP	2009
DIA FAMILIAR DE PESCA 2009	RINCON	PR	NOV	2009
TORNEO AGUJA AZUL CLUB NAUTICO DE BOQUERON	BOQUERON	PR	SEP	2010
6TH TORNEO DE MARLIN MARINA BOQUERON	BOQUERON	PR	OCT	2010
AMERICAN CARIBBEAN CHALLENGE	CABO ROJO	PR	SEP	2010
XXII INTL LIGHT TACKLE BLUE MARLIN TOURNAMENT	CABO ROJO	PR	SEP	2010
MAYAGUEZ BILLFISH TOURNAMENT 2010	MAYAGUEZ	PR	JUN	2010
2DO CIRCUITO VELA-PETO	MAYAGUEZ	PR	NOV	2010
TORNEO DE AGUJA AZUL CLUB NAUTICO DE BOQUERON	BOQUERON	PR	SEP	2011
INTERNATIONAL LIGHT TACKLE BLUE MARLIN	CABO ROJO	PR	OCT	2011
TORNEO DE DAMAS DE LA ASOCIACION DE PESCA DE PR	CABO ROJO	PR	OCT	2011
3ER CIRCUITO VELA-PETO	MAYAGUEZ	PR	OCT	2011
TORNEO DE AGUJA AZUL CLUB NAUTICO DE BOQUERON	BOQUERON	PR	OCT	2012
XXIV BLUE MARLIN LIGHT TACKLE TOURNAMENT	CABO ROJO	PR	OCT	2012
4TO CIRCUITO VELA PETO (CLUB NAUTICO DE MAYAGUEZ)	MAYAGUEZ	PR	OCT	2012
TORNEO DE AGUJA AZUL CLUB NAUTICO DE BOQUERON	BOQUERON	PR	OCT	2013
XXV INTERNATIONAL LIGHT TACKLE BLUE MARLIN TOURNEY	CABO ROJO	PR	OCT	2013
5TO CIRCUITO VELA-PETO	MAYAGUEZ	PR	OCT	2013

The target species in these tournaments were, in order of prevalence: blue marlin, white marlin, sailfish, tunas, and swordfish. There were no shark tournaments. The three tournaments on Puerto Rico's west coast that were conducted in October 2013 targeted blue marlin and sailfish exclusively. This could indicate that October is an important month for blue marlin and sailfish fishing on the west coast of Puerto Rico.

In conclusion, the available data indicate that recreational fishing for HMS is an important activity for many Puerto Ricans. In particular, catch and release fishing for blue marlin and other billfish is popular. Yellowfin tuna, skipjack tuna, and swordfish are also recreationally targeted in Puerto Rico. Most tournaments on the west coast have historically occurred from September through March.

3.3 Economic and Social Environment

3.3.1 Economic Description of the Puerto Rico Commercial and Recreational Fishing Industries

3.3.1.1 Commercial Fisheries

The data presented here for commercial fisheries comes from individual trip reports. All tables reporting landings are in whole pounds. Landings come from state and federal waters. When the data shows that less than three vessels landed poundage for a particular category, the data is confidential and this is indicated in the table and explained in the notes at the bottom of the table.

The first set of tables in this section (Table 3.3.1.1 to Table 3.3.1.9) shows annual and monthly trips, landings and revenues (2013 dollars using CPI deflator) by annual catch limit (ACL) unit for all of Puerto Rico for 2008-2011. The 2012 data is incomplete. The second set of tables in this section (Table 3.3.1.11 to Table 3.3.1.14) shows landings and revenues (2013 dollars using CPI deflator) for the west coast of Puerto Rico since this is the area of focus for this amendment. Landings made on a smaller scale, such as within each of the protected areas, are not available in individual trip reports and no other data sources are available at this time. The third set of tables shows information, when possible, about the specific species discussed in the biological section. The tables in this third set contain species known to occur within Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. These tables are not meant to be comprehensive but simply an example of species known to occur in the areas.

<u>Puerto Rico</u>

Trips

Table 3.3.1.1 shows the change in number of commercial trips, pounds, and associated revenue over the period 2008-2011. The data for 2012 was incomplete at the time this amendment was written. Expanded landings (corrected) are reported in the table. Expanded pounds (corrected) are an expansion of reported pounds. An expansion factor was used to deal with non-reporting or inaccurate reporting by commercial fishermen. Expanded pounds are the pounds that were used to establish ACLs. Ex-vessel revenue was estimated based on the expanded pounds. The number of trips has not been expanded because there is no agreed upon methodology for doing this. Regardless, they are included here to show possible trends in number of trips taken.

In the past five years, the number of commercial fishing trips averaged approximately 54,000 trips annually, average landings were almost 3 million pounds (whole), and ex-vessel revenues averaged

almost $9 million (Table 3.3.1.1). Number of trips peaked in 2011 while pounds landed and ex-vessel revenue peaked in 2008 (see note below Table 3.3.1.1 for a possible explanation of this inconsistency).

Table 3.3.1.1. Annual Number of Commercial Trips, Landings (Whole Pounds), and Ex-Vessel Revenue (2013 Dollars) for Puerto Rico, 2008-2011.

Year	Number of Trips	Landings (Whole Pounds)	Estimated Ex-Vessel Revenue (2013 Dollars)
2008	52,724	3,356,620	$9,969,566
2009	55,771	2,849,139	$9,022,226
2010	48,810	2,812,295	$9,230,652
2011	57,810	2,057,031	$6,998,077
Average	**53,779**	**2,768,771**	**$8,805,130**

Source: Southeast Fisheries Science Center, January 2014.

Note: While pounds have been expanded consistent with the approach taken in determining appropriate ACLs, the estimated ex-vessel revenue column was calculated using ex-vessel prices from reported landings and values. The reader should note that the number of trips have not been expanded but have been taken directly from the trip report data.

Table 3.3.1.2 shows the number of commercial trips by month for each year.

Table 3.3.1.2. Monthly Number of Commercial Trips for Puerto Rico, 2008-2011.

Month	2008	2009	2010	2011
January	4,758	4,770	4,397	4,521
February	4,908	4,616	4,492	4,148
March	4,736	4,874	4,717	4,423
April	4,632	4,273	3,650	5,004
May	5,204	4,663	4,723	5,246
June	4,593	5,571	4,667	5,299
July	4,852	4,864	3,876	5,407
August	4,987	4,657	4,220	4,923
September	4,024	4,609	3,460	5,075
October	3,714	5,131	3,521	4,791
November	3,280	4,105	3,481	4,886
December	3,036	3,638	3,606	4,087

Source: Southeast Fisheries Science Center, January 2014.

Note: The reader should note that the number of trips have not been expanded but have been taken directly from the trip report data.

Table 3.3.1.3 shows the number of commercial trips when a specific species within the ACL unit was caught. The actual number of vessel trips is less than this because multiple species belonging to different ACL units are caught on the same trip. That is, while spiny lobster and snapper might have been caught on the same trip, this table will count it as two trips.

Several of these ACL units contain species of particular interest in this amendment. Specific species landings are discussed below and shown in Table 3.3.1.15.

Table 3.3.1.3. Number of Commercial Trips by Species Group/Complex for Puerto Rico, 2008-2011.

Species Group/Complex	2008	2009	2010	2011	Average
AQUARIUM TRADE	0	9	5	2	4
BOXFISHES	2,746	2,869	2,504	2,820	2,735
GOATFISHES	326	395	328	335	346
GROUPERS	2,857	2,953	2,670	3,151	2,908
GRUNTS	2,050	2,366	1,833	1,335	1,896
JACKS	1,409	1,474	1,090	1,235	1,302
PARROTFISH UNIT	1,751	1,973	1,581	1,565	1,718
PORGIES	1,113	1,098	794	919	981
QUEEN CONCH	4,232	4,740	4,309	5,919	4,800
SNAPPER UNIT 1	2,506	2,231	2,281	2,828	2,462
SNAPPER UNIT 2	1,635	1,258	1,608	2,014	1,629
SNAPPER UNIT 3	5,354	5,874	5,251	5,756	5,559
SNAPPER UNIT 4	2,682	2,691	2,556	2,879	2,702
SNAPPER UNIT 5	2,007	2,411	1,919	2,019	2,089
SPINY LOBSTER	7,925	8,490	7,290	9,357	8,266
SQUIRRELFISHES	499	418	515	478	478
TILEFISHES	0	0	3	0	1
TRIGGERFISHES AND FILEFISHES	2,190	2,406	2,032	2,869	2,374
WRASSES	2,735	3,081	2,482	3,109	2,852
Misc Species w/o an ACL	8,707	9,034	7,759	9,220	8,680
Total	**52,724**	**55,771**	**48,810**	**57,810**	**53,779**

Source: Southeast Fisheries Science Center, January 2014.

Landings and Revenue

Table 3.3.1.4 shows annual landings by ACL unit and Table 3.3.1.5 shows annual revenue by ACL unit for Puerto Rico for 2008-2011. Both tables rely on estimates of expanded pounds used in the calculation of ACLs.

Table 3.3.1.4. Annual Commercial Landings (Whole Pounds) by Species Group/Complex for Puerto Rico, 2008-2011.

	Landings (Whole Pounds)			
Species Group/Complex	**2008**	**2009**	**2010**	**2011**
BOXFISHES	51,397	58,979	57,310	40,326
GOATFISHES	5,215	9,656	6,459	6,812
GROUPERS	87,738	87,135	92,162	59,715
GRUNTS	69,575	84,537	65,601	39,954
JACKS	104,498	88,385	67,589	35,528
PARROTFISH UNIT	90,450	54,555	43,909	38,154
PORGIES	28,328	23,539	15,693	19,655
QUEEN CONCH	242,041	273,309	273,459	235,759
SNAPPER UNIT 1	352,975	369,179	276,528	149,268
SNAPPER UNIT 2	261,998	239,977	384,877	218,854
SNAPPER UNIT 3	175,321	148,127	174,108	167,303
SNAPPER UNIT 4	365,868	222,698	215,404	151,284
SNAPPER UNIT 5	54,523	47,426	52,909	38,317
SPINY LOBSTER	329,227	322,992	289,609	274,318
SQUIRRELFISHES, TILEFISHES, AQUARIUM TRADE	19,430	10,485	8,995	6,744
TRIGGERFISHES AND FILEFISHES	55,361	47,194	45,650	50,714
WRASSES	54,980	67,187	59,427	53,623
Misc Species w/o an ACL	1,007,695	693,779	682,606	470,703
Total	**3,356,620**	**2,849,139**	**2,812,295**	**2,057,031**

Source: Southeast Fisheries Science Center, January 2014.

Table 3.3.1.5. Annual Commercial Ex-Vessel Revenue (2013 Dollars) by Species Group/Complex for Puerto Rico, 2008-2011.

	Ex-Vessel Revenues (2013 Dollars)			
Species Group/Complex	**2008**	**2009**	**2010**	**2011**
BOXFISHES	$113,356	$131,752	$191,616	$87,318
GOATFISHES	$13,258	$25,252	$16,225	$0
GROUPERS	$219,447	$214,146	$209,465	$154,404
GRUNTS	$125,809	$166,358	$129,351	$73,859
JACKS	$177,706	$158,605	$116,237	$65,696
PARROTFISH UNIT	$172,228	$111,664	$88,068	$70,338
PORGIES	$55,114	$50,339	$33,076	$36,222
QUEEN CONCH	$1,050,262	$1,234,810	$1,279,102	$1,112,568
SNAPPER UNIT 1	$1,261,990	$1,311,379	$1,075,257	$592,542
SNAPPER UNIT 2	$969,141	$797,051	$1,371,999	$907,333
SNAPPER UNIT 3	$438,328	$368,707	$432,135	$430,207
SNAPPER UNIT 4	$926,200	$556,194	$524,960	$379,709
SNAPPER UNIT 5	$135,523	$119,548	$127,344	$90,955
SPINY LOBSTER	$2,170,107	$2,153,304	$1,900,584	$1,763,396
SQUIRRELFISHES, TILEFISHES, AQUARIUM TRADE	$31,706	$18,887	$15,392	$11,094
TRIGGERFISHES AND FILEFISHES	$102,861	$91,553	$81,175	$82,029
WRASSES	$174,885	$208,899	$184,519	$166,476
Misc Species w/o an ACL	$1,831,644	$1,303,779	$1,454,146	$973,931
Total	**$9,969,566**	**$9,022,226**	**$9,230,652**	**$6,998,077**

Source: Southeast Fisheries Science Center, January 2014.

Note: To avoid confidentiality issues, Tilefishes Unit and Aquarium Trade Unit were combined with the Squirrelfish Unit.

Table 3.3.1.6 shows monthly landings for 2008-2011 and Table 3.3.1.7 shows monthly ex-vessel revenue for 2008-2011. These figures were not replicated by ACL unit because of confidentiality issues for species with lower landings.

Table 3.3.1.6. Monthly Commercial Landings (Whole Pounds) for Puerto Rico, 2008-2011.

Month	2008	2009	2010	2011
Jan	274,570	300,683	251,954	158,306
Feb	320,682	347,776	280,790	133,528
March	325,607	288,208	299,723	154,072
April	303,847	242,505	224,999	179,797
May	339,977	240,133	253,713	182,967
June	310,821	267,524	255,259	179,123
July	342,423	215,254	211,204	183,384
August	327,310	182,084	227,455	163,741
Sept	238,450	213,080	214,881	178,360
Oct	223,993	224,086	231,397	182,025
Nov	189,878	190,379	174,999	200,848
Dec	159,062	137,427	185,921	160,880
Total	**3,356,620**	**2,849,139**	**2,812,295**	**2,057,031**

Source: Southeast Fisheries Science Center, January 2014.

Table 3.3.1.7. Monthly Commercial Ex-Vessel Revenue (2013 Dollars) for Puerto Rico, 2008-2011.

Month	2008	2009	2010	2011
Jan	$815,506	$1,135,818	$1,093,527	$1,196,323
Feb	$952,464	$1,067,911	$1,135,129	$993,798
March	$967,092	$1,030,421	$1,255,046	$1,054,218
April	$902,462	$950,307	$873,273	$1,300,004
May	$1,009,773	$894,804	$1,034,917	$1,383,029
June	$923,176	$1,016,304	$1,071,997	$1,389,641
July	$1,017,038	$812,261	$780,477	$1,418,093
Aug	$972,150	$801,792	$871,425	$1,200,196
Sept	$708,225	$822,781	$770,596	$1,334,325
Oct	$665,286	$939,711	$940,644	$1,264,835
Nov	$563,961	$768,836	$1,077,147	$1,452,281
Dec	$472,433	$721,905	$837,061	$1,164,249
Total	**$9,969,566**	**$9,022,226**	**$9,230,652**	**$6,998,077**

Source: Southeast Fisheries Science Center, January 2014.

Note: The monthly estimated ex-vessel revenues for all species landed contained in Table 3.3.1.7 were calculated using the weighted average annual price derived from an ex-vessel revenue raw data (not shown here) which contains revenue and pounds harvested by species. The weighted average annual price was determined by the proportion of each species in the total landings. For example, assume only two species were harvested, species X, which had an average price per pound of $4 and constituted 75% of total landings, and species Y, which had an average price per pound of $1 and constituted 25% of total landings. The weighted average price across both species would be equal to $3.25 ((0.75*$4) + (0.25*$1)). In Table 3.3.1.7, the same weighted average price per year is used for each month.

Gear Usage

Tables 3.3.1.8 and 3.3.1.9 show landings and ex-vessel revenue, respectively, by gear type for 2008-2011. Bottom hook and line and diving have been used to bring in the most landings and ex-vessel revenue.

Table 3.3.1.8. Annual Commercial Landings (Whole Pounds) by Gear Type for Puerto Rico, 2008-2011.

Gear Type	2008	2009	2010	2011
BY HAND, DIVING GEAR	675,003	670,655	669,554	540,473
CAST NETS	120,184	47,167	60,504	26,822
GILL NETS, OTHER	270,235	174,462	156,844	127,655
HAUL SEINES	8,707	47,342	32,643	43,603
HOOK AND LINE	32,735	24,420	6,103	1,131
HOOK AND LINE, BOTTOM	1,652,593	1,069,068	1,305,273	813,901
LONG LINES, BOTTOM	24,382	12,165	58,737	27,794
POTS AND TRAPS	11,055	8,244	13,164	8,958
POTS AND TRAPS, FISH	285,659	335,339	279,940	241,096
TRAPS, SPINY LOBSTER	39,875	36,478	45,308	68,576
SPEARS	0	0	0	69,207
TRAMMEL NETS	34,268	177,990	45,921	14,879
TROLL LINES	201,924	245,809	138,204	72,936
Total	**3,356,620**	**2,849,139**	**2,812,195**	**2,057,031**

Source: Southeast Fisheries Science Center, January 2014.

Table 3.3.1.9. Annual Commercial Ex-Vessel Revenue (2013 Dollars) by Gear Type for Puerto Rico, 2008-2011.

Gear Type	2008	2009	2010	2011
BY HAND, DIVING GEAR	$2,008,464	$2,126,452	$2,195,997	$1,841,539
CAST NETS	$357,606	$149,553	$198,440	$91,390
GILL NETS, OTHER	$804,081	$553,168	$514,415	$434,955
HAUL SEINES	$25,908	$150,108	$107,062	$148,567
HOOK AND LINE	$97,403	$77,429	$20,017	$3,854
HOOK AND LINE, BOTTOM	$4,917,273	$3,389,704	$4,281,022	$2,773,183
LONG LINES, BOTTOM	$72,548	$38,572	$192,645	$94,702
POTS AND TRAPS	$32,894	$26,139	$43,175	$30,522
POTS AND TRAPS, FISH	$849,975	$1,063,262	$918,145	$821,480
POTS AND TRAPS, SPINY LOBSTER	$118,648	$115,661	$148,601	$233,657
SPEARS	$0	$0	$0	$235,807
TRAMMEL NETS	$101,964	$564,355	$150,611	$50,697
TROLL LINES	$600,823	$779,389	$453,280	$248,513
Total	**$9,969,566**	**$9,022,226**	**$9,230,652**	**$6,998,077**

Source: Southeast Fisheries Science Center, January 2014.

Note: Ex-vessel revenue was calculated using expanded pounds for each year multiplied by annual ex-vessel prices (from non-expanded pounds) in 2013 dollars for each gear type.

For more information see economic descriptions of the Puerto Rico commercial and recreational fishing industries in Amendment 2 to the FMP for the Queen Conch fishery (CFMC 2011a), Amendment 5 to the FMP for the Reef Fish Fishery (CFMC 2011a), Amendment 6 to the Reef Fish FMP (CFMC 2011b), Amendment 5 to the Spiny Lobster FMP (CFMC 2011b), Amendment 3 to the Queen Conch FMP (CFMC 2011b), and Amendment 3 to the FMP for Corals and Reef Associated Plants and Invertebrates of Puerto Rico and the USVI (CFMC 2011b). The economic description information contained in these amendments is incorporated herein by reference.

West Coast of Puerto Rico

This section provides information about the West Coast of Puerto Rico. In some instances, confidential data prevents the ability to show monthly data or data by species. Table 3.3.1.10 shows West Coast annual trips, landings, and revenues from 2008-2011. Tables 3.3.1.11 and 3.3.1.12 show West Coast landings (whole pounds) and ex-vessel revenues (2013 dollars) by ACL unit. Tables 3.3.1.13 and 3.3.1.14 show West Coast landings (whole pounds) and ex-vessel revenues (2013 dollars) by gear type.

Table 3.3.1.10. Regional Annual Commercial Trips, Landings (Whole Pounds), and Ex-Vessel Revenues (2013 dollars) by ACL Unit, 2008-2011.

Region and Year	Number of Trips	Landings (pounds)	Ex-Vessel Revenues (2013 dollars)
EAST			
2008	6,698	340,052	$1,133,936
2009	5,490	497,799	$1,693,980
2010	5,030	510,408	$1,814,786
2011	7,016	375,789	$1,403,522
Average	6,059	431,012	$1,511,556
INLAND			
2008	62	1,490	$1,809
2009	21	431	$544
2010	2	21	$126
2011	79	5,212	$17,775
Average	41	1,789	$5,064
NORTH			
2008	3,049	1,394,218	$3,803,369
2009	2,403	753,238	$2,192,688
2010	3,001	742,488	$2,164,776
2011	4,456	206,069	$618,323
Average	3,227	774,003	$2,194,789

SOUTH			
2008	18,696	526,631	$1,750,439
2009	23,236	351,194	$1,172,000
2010	19,010	310,703	$1,112,313
2011	19,024	601,578	$2,004,579
Average	19,992	447,527	$1,509,833
WEST			
2008	24,219	1,094,229	$3,574,105
2009	24,621	1,246,477	$4,013,294
2010	21,767	1,248,675	$4,207,021
2011	27,235	868,383	$3,066,827
Average	24,461	1,114,441	$3,715,312

Source: Southeast Fisheries Science Center, January 2014.
Note: Ex-vessel revenue was calculated using expanded pounds for each year multiplied by annual ex-vessel prices (from non-expanded pounds) in 2013 dollars for each gear type.

As Table 3.3.1.10 shows, the West Coast of Puerto Rico takes 45% of the total number of trips, 40% of landings, and approximately 42% of ex-vessel revenues. Both landings and revenue were relatively stable from 2008-2010 but both decreased by approximately 30% in 2011. In that same year, trips increased by 25% from the previous year. Table 3.3.1.11 shows that landings appear to have decreased from 2010 to 2011 in several ACL unit categories. Commercial landings of Snapper Unit 2, queen conch, spiny lobster and species not in an ACL unit contributed most to total landings in 2011.

Table 3.3.1.11. West Coast Annual Commercial Landings (Whole Pounds) by ACL Unit, 2008-2011.

ACL Unit	2008	2009	2010	2011
BOXFISHES	25,801	35,992	30,543	21,031
GROUPERS	45,666	50,229	51,858	29,255
GRUNTS	13,515	21,936	8,625	4,438
JACKS	9,243	20,492	10,054	5,020
PARROTFISH UNIT	9,414	12,563	4,495	2,960
PORGIES	2,171	2,419	898	693
QUEEN CONCH	119,796	174,656	168,110	128,505
SNAPPER UNIT 1	139,735	115,169	112,305	86,099
SNAPPER UNIT 2	207,049	216,320	269,298	188,880
SNAPPER UNIT 3	47,315	56,484	66,777	37,666
SNAPPER UNIT 4	28,614	38,332	40,880	22,987
SNAPPER UNIT 5	10,645	13,991	13,207	7,995
SPINY LOBSTER	142,271	156,058	147,011	100,380
SQUIRRELFISHES, GOATFISH,	494	483	686	463

ACL Unit	2008	2009	2010	2011
AQUARIUM TRADE, TILEFISHES				
TRIGGERFISHES AND FILEFISHES	17,190	24,674	24,407	19,732
WRASSES	13,575	18,494	18,870	13,404
MISC SPECIES W/O AN ACL	261,735	288,185	280,651	198,875

Source: Southeast Fisheries Science Center, January 2014.
Note: To avoid confidentiality issues, Goatfish, Aquarium Trade, Tilefish, and Squirrelfish Units were combined.

Table 3.3.1.12. West Coast Annual Commercial Ex-Vessel Revenues (2013 Dollars) by ACL Unit, 2008-2011.

ACL Unit	2008	2009	2010	2011
BOXFISHES	$61,382	$87,637	$72,910	$50,662
GROUPERS	$108,184	$116,844	$108,447	$73,311
GRUNTS	$14,486	$35,866	$12,106	$4,591
JACKS	$12,817	$32,456	$12,518	$7,201
PARROTFISH UNIT	$11,186	$22,807	$7,383	$3,831
PORGIES	$3,828	$3,522	$1,349	$1,150
QUEEN CONCH	$527,811	$784,837	$763,775	$596,604
SNAPPER UNIT 1	$495,851	$409,459	$434,467	$345,320
SNAPPER UNIT 2	$760,780	$711,916	$951,748	$777,716
SNAPPER UNIT 3	$112,137	$134,392	$156,877	$90,182
SNAPPER UNIT 4	$62,594	$83,821	$88,617	$48,288
SNAPPER UNIT 5	$25,196	$33,405	$28,806	$18,044
SPINY LOBSTER	$920,701	$1,011,959	$932,867	$629,253
SQUIRRELFISHES, GOATFISH, AQUARIUM TRADE, TILEFISHES	$677	$964	$1,424	$407
TRIGGERFISHES AND FILEFISHES	$26,656	$43,627	$37,754	$28,801
WRASSES	$43,823	$58,203	$60,250	$42,068
MISC SPECIES W/O AN ACL	$386,275	$441,348	$534,608	$349,006

Source: Southeast Fisheries Science Center, January 2014.
Note: To avoid confidentiality issues, Goatfish, Aquarium Trade, Tilefish, and Squirrelfish Units were combined.
Note: Ex-vessel revenue was calculated using expanded pounds for each year multiplied by annual ex-vessel prices (from non-expanded pounds) in 2013 dollars for each ACL unit.

Table 3.3.1.11 shows that snapper, queen conch and spiny lobster landings dominated landings on the West Coast of Puerto Rico and contributed significantly to total landings for Puerto Rico. The West Coast contributed 64% of Snapper Unit 2 landings, 47% of Snapper Unit 1 landings, 39% of Queen Conch landings and 27% of Spiny Lobster landings in 2011. The West Coast also landed almost half (45%) of boxfish landings and 26% of Grouper Unit landings in 2011 (see Tables 3.3.1.11 and 3.3.1.4). Ex-vessel revenue contributions from the West Coast were similar with the West Coast landings taking 86% of total Snapper Unit 2 ex-vessel revenues, 58% of Snapper Unit 1 revenues, 54% of Queen Conch

Unit revenues, 36% of Spiny Lobster Unit revenues, 58% of Boxfish Unit revenues, and 47% of Grouper Unit revenues in 2011 (see Tables 3.3.1.12 and 3.3.1.5).

The dominant gear usage, with regard to landings, on the West Coast was hook and line followed by diving gear. In 2011, the West Coast took 49% of the landings and 52% of ex-vessel revenues in Puerto Rico with hook and line gear and 55% of landings and 67% of ex-vessel revenues for Puerto Rico with dive gear (see Tables 3.3.1.13 and 3.3.1.8 for landings and Tables 3.3.1.14 and 3.3.1.9 for ex-vessel revenues).

Table 3.3.1.13. West Coast Commercial Landings (Whole Pounds) by Gear Usage, 2008-2011.

Gear Type	2008	2009	2010	2011
BY HAND, DIVING GEAR	336,652	386,974	372,837	263,138
CAST NETS	1,479	555	538	2,861
GILL NETS, OTHER	22,084	60,267	35,554	23,842
HAUL SEINES	2,068	19,293	21,193	19,395
HOOK AND LINE	592	6,115	0	0
HOOK AND LINE, BOTTOM	543,398	534,197	628,552	446,183
LONG LINES, BOTTOM	870	3,367	4,681	1,652
POTS AND TRAPS	24	148	69	252
POTS AND TRAPS, FISH	51,107	89,485	80,774	48,226
POTS AND TRAPS, SPINY LOBSTER	2,681	0	49	1,046
SPEARS	0	0	0	24,098
TRAMMEL NETS	29,245	22,304	42,382	5,971

Source: Southeast Fisheries Science Center, January 2014.

Table 3.3.1.14. West Coast Commercial Ex-Vessel Revenues (2013 Dollars) by Gear Usage, 2008-2011.

Gear Type	2008	2009	2010	2011
BY HAND, DIVING GEAR	$1,499,715	$1,798,879	$1,693,242	$1,228,306
CAST NETS	$1,944	$856	$680	$3,101
GILL NETS, OTHER	$44,627	$95,040	$66,440	$35,694
HAUL SEINES	$12,283	$36,595	$32,860	$25,083
HOOK AND LINE	$989	$9,337	$0	$0
HOOK AND LINE, BOTTOM	$1,560,949	$1,442,541	$1,816,475	$1,432,980
LONG LINES, BOTTOM	$2,814	$10,813	$14,637	$4,768
POTS AND TRAPS	$21	$732	$663	$2,096
POTS AND TRAPS, FISH	$204,576	$348,955	$297,567	$187,409
POTS AND TRAPS, SPINY LOBSTER	$16,861	$0	$132	$6,396
SPEARS	$0	$0	$0	$55,516
TRAMMEL NETS	$80,940	$53,870	$186,492	$17,562

Source: Southeast Fisheries Science Center, January 2014.
Note: Ex-vessel revenue was calculated using expanded pounds for each year multiplied by annual ex-vessel prices (from non-expanded pounds) in 2013 dollars for each gear type.

Species of Particular Concern in this Amendment

In the biological section above, in addition to the ACL units they fall under, dog snapper, schoolmaster snapper, yellowtail snapper, red hind, Nassau, yellowfin grouper, and tiger grouper are described in some detail. The tables below provide landings and ex-vessel revenue information when possible. While dog snapper, schoolmaster snapper and tiger grouper landings are all confidential, the remaining species listed above are not and therefore shown below.

Table 3.3.1.15. Commercial Trips, Landings (Whole Pounds) and Ex-Vessel Revenue (2013 Dollars) for Yellowtail Snapper, Red Hind, Nassau, and Yellowfin Grouper, 2008-2011.

	Puerto Rico (All Regions)			West Coast		
Species	**Trips**	**Landings**	**Ex-Vessel Revenue**	**Trips**	**Landings**	**Ex-Vessel Revenue**
Yellowtail Snapper						
2008	2,681	365,868	$925,646	569	28,614	$72,393
2009	2,683	222,698	$556,745	652	38,332	$95,830
2010	2,506	215,404	$525,586	618	40,880	$99,747
2011	2,851	151,284	$379,723	712	22,987	$57,697
Red Hind						
2008	1,020	39,640	$88,397	744	20,018	$44,640
2009	1,082	39,790	$96,292	797	22,759	$55,076
2010	1,220	47,174	$101,896	919	30,953	$66,859
2011	1,783	35,075	$85,232	1,222	15,771	$38,324
Nassau						
2008	53	2,226	$4,118	43	1,520	$2,812
2009	103	7,901	$13,906	93	6,127	$10,784
2010	27	968	$2,381	17	398	$979
2011	10	319	$893	6	271	$759
Yellowfin Grouper						
2008	108	2,637	$6,197	43	1,688	$3,967
2009	59	2,563	$6,203	24	1,637	$3,962
2010	87	2,865	$6,647	7	356	$826
2011	64	1,420	$3,351	15	427	$1,008

Source: Southeast Fisheries Science Center, January 2014.

Note: Ex-vessel revenue was calculated using expanded pounds for each year multiplied by annual ex-vessel prices (from non-expanded pounds) in 2013 dollars for each gear type.

3.3.1.2 Recreational Fishery

This section presents information from the MRIP Program from the NOAA Office of Science and Technology website found at http://www.st.nmfs.noaa.gov/recreational-fisheries/access-data/run-a-data-query/index.

Puerto Rico

In 2012, 94,000 marine recreational participants took 351,000 trips and caught a total of 526,000 fish. The most commonly caught non-bait species (in numbers of fish) were dolphinfish, silk snapper, anchovy family, lane snapper, and blue runner. By weight, the largest harvests were dolphinfish, wahoo, common snook, tripletail, great barracuda, and king mackerel (Fisheries of the U.S., 2012).

Catch and Harvest

Table 3.3.1.16 shows the number of fish harvested and released through recreational fishing.

Table 3.3.1.16. Total Recreationally Harvested and Released Numbers of Fish in Puerto Rico, 2008-2012.

Year	Harvested	Released
2008	1,341,257	176,930
2009	663,590	119,179
2010	392,624	156,115
2011	387,316	58,980
2012	477,730	48,664

Source: Marine Recreational Information Program (MRIP) (http://www.st.nmfs.noaa.gov/recreational-fisheries/access-data/run-a-data-query/index)

Effort (Angler Trips)

Table 3.3.1.17 shows the total number of angler trips in Puerto Rico while Table 3.3.1.18 breaks down the number of angler trips by mode (shore, charter boat and private/rental boat).

Table 3.3.1.17. Total Recreational Angler Trips in Puerto Rico, 2008-2012.

Year	Angler Trips
2008	798,551
2009	636,151
2010	536,183
2011	424,587
2012	350,568

Source: Marine Recreational Information Program (MRIP) (http://www.st.nmfs.noaa.gov/recreational-fisheries/access-data/run-a-data-query/index)

Table 3.3.1.18. Total Recreational Angler Trips by Mode in Puerto Rico, 2008-2012.

Year	Shore	Charter Boat	Private/Rental Boat
2008	423,190	12,622	362,739
2009	345,584	2,610	287,957
2010	219,651	4,113	312,419
2011	232,917	4,730	186,939
2012	140,266	1,839	208,462

Source: Marine Recreational Information Program (MRIP) (http://www.st.nmfs.noaa.gov/recreational-fisheries/access-data/run-a-data-query/index)

Participation

Table 3.3.1.19 shows individual participation in recreational fishing in Puerto Rico.

Table 3.3.1.19. Recreational Participation by Region (individuals) in Puerto Rico, 2008-2012.

Year	Coastal Resident	Out of State
2008	127,863	21,681
2009	110,236	22,352
2010	92,191	11,096
2011	98,662	13,795
2012	83,837	10,003

Source: Marine Recreational Information Program (MRIP) (http://www.st.nmfs.noaa.gov/recreational-fisheries/access-data/run-a-data-query/index)

Economic Value and Expenditures

There is no information at this time regarding economic value and expenditures of recreational fishing in the U.S. Caribbean.

Summary

In general, there has been a downward trend in harvest, releases, number of trips and recreational fishing participation since 2008. The reason for this could be the increase in diesel prices and/or the downturn in the economy, which could result in less expenditures on recreational fishing.

3.3.2 Social and Cultural Environment

This amendment proposes changes to three seasonally closed areas including Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. These seasonally closed areas are located off the west coast of Puerto Rico. Therefore, this section includes a description of fishermen and fishing communities in Puerto Rico in relation to these seasonally closed areas. Fishing in Puerto Rico in general is included in order to provide context, as well as general information where it is not available at a lower level of analysis. Also, fishing and fishermen along the west coast of Puerto Rico are detailed to provide information on fishermen specifically engaged in west coast fishing. Information on fishermen engaged in fishing in the seasonally closed areas and the opinions of these fishermen related to the managed areas are also included in order to aid in assessing possible impacts resulting from the proposed changes in the seasonally closed areas.

Profiles of the west coast regions of Puerto Rico (divided into the western metro region and northwest region) and locations dependent on fishing in Puerto Rico are included as profiles in Griffith et al. (2007) and are included herein by reference. These profiles include such elements as the demographic characteristics of residents, involvement in commercial and recreational fishing by residents, and a history of the community or larger area.

Data in the following description are presented at the community level, when possible, in order to meet the requirements of National Standard 8 (NS8) of the Magnuson-Stevens Act. NS8 requires the consideration of the importance of fishery resources to human communities when changes in fishing regulations are considered. For the following analysis, a large portion of these data are presented at the commonwealth level because data are not available at the place-based community level of analysis.

Puerto Rico Fishing Community

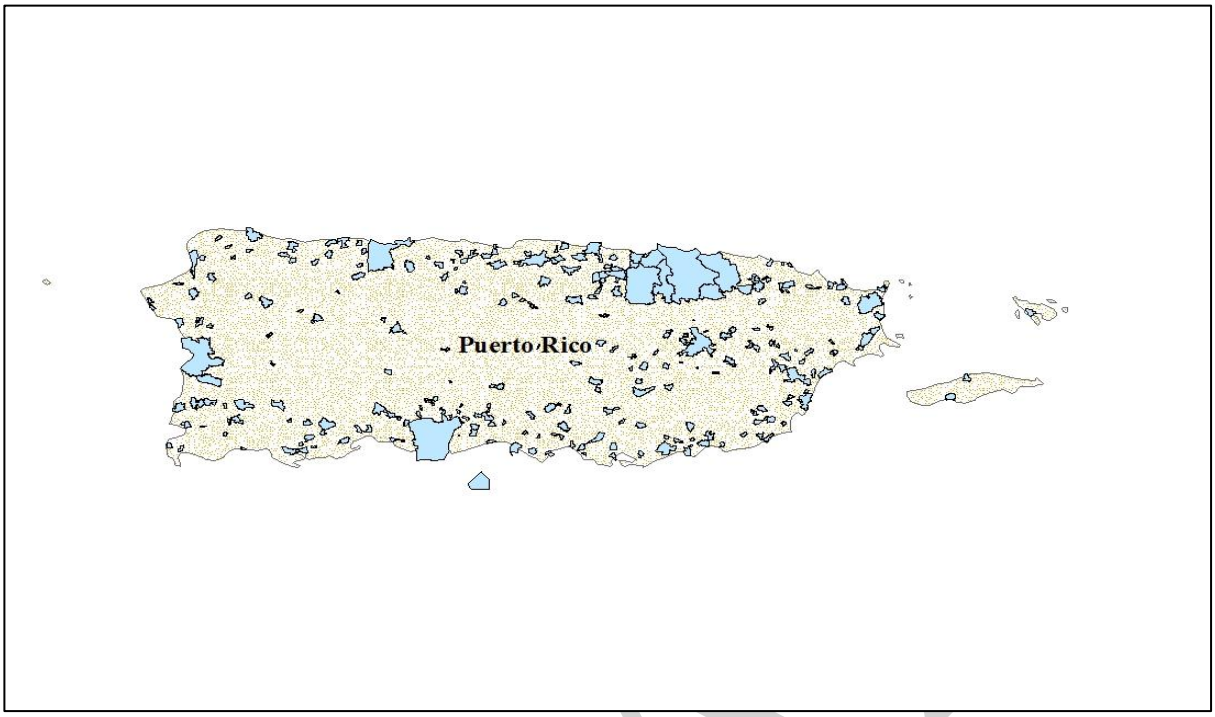


Figure 3.3.2.1. Map of Puerto Rico with census designated places. Source: NMFS SERO Fisheries Social Science Branch, M.Jepson.

Fishing traditions in coastal communities in Puerto Rico are visible through the celebration of the Virgen del Carmen, the patron saint of fishers, which derives from the fishing and maritime tradition of Spain. In addition, more recent traditions are visible through the Festival Del Pescao (Seafood Festival) in Cabo Rojo, a festival which was created during the 1970s and occurs during Lent. Fish are important and culturally significant to the Puerto Rican diet. Fish are particularly important among Catholics during Lent, which includes one of the most brisk seasons for seafood sales. Fish is both a high-priced food enjoyed by tourists and coastal visitors and a low-cost and high quality protein which is sold to working people (Griffith et al. 2007).

As with most island coastal economies, there are three main types of fisheries in Puerto Rico: commercial, recreational, and subsistence. The commercial sector is responsible for the majority of landings. Puerto Rico's commercial fishery has been referred to as "artisanal" and can be considered small-scale and family-based (Griffith et al. 2007). Most fishing operations are multi-gear and multi-species according to Griffith et al. (2007) with nearly two-thirds utilizing at least three gear types. A number of different gear types are used by Puerto Rican fishermen, including: handline, rod & reel, longline, bottomline, fish traps, lobster traps, gill nets, trammel nets, cast nets and SCUBA gear (Matos-Caraballo and Agar 2011). There seems to be an increase in the use of SCUBA gear in the commercial fisheries.

In 2011 and 2012, the number of commercial fishermen in Puerto Rico more than doubled (3,408) from the number reported in 2009 (E. Piñeiro, personal communication). The increase in the number of commercial fishermen was likely due to the moratorium on the historical requirement to submit tax forms to be used by the Puerto Rico Department of Natural and Environmental Resources to determine the amount of income a fisher derived from commercial fishing. This moratorium on the requirement to show tax forms when applying for a commercial license was put in place in 2011; however the tax requirement was reinstated in 2013. According to a recent census conducted in Puerto Rico, there were approximately 868 active commercial fishermen in 2008 (Matos-Caraballo and Agar 2011). This number is highly contested though, as pointed out in Griffith et al. (2007), and in the past even a range of 1,500 to 2,500 has been suggested too low by fishermen. The confusion may be attributed to what an active fisherman is considered to be. Nevertheless, the number has decreased from an earlier census conducted in 1988 when there were over 1,700 fishermen or the 2003 census which counted 1,132. Nearly 7 % of fishermen reported that they worked full-time as fishermen; whereas 25% reported that they worked part-time as fishermen and held other occupations or received retirement benefits (Matos-Caraballo and Agar 2011).

Out of the 868 commercial fishermen interviewed in a recent census, reef fish was the top category in terms of importance with 77.3% of respondents targeting reef fish (Table 3.3.2.1). Deepwater snapper was the second most commonly targeted category (55.5%), and spiny lobster was the third (49.3%).

Along the west coast of Puerto Rico specifically, the top targeted categories included reef fish (64.8%), deep-water snapper (51.3%), spiny lobster (47.2%), queen conch (34.6%), and pelagic species (26.4%, Table 3.4.2.1). Reef fish targeted along the west coast include species such as yellowtail, lane, and mutton snappers; deep-water snappers targeted include species such as silk and queen snapper; pelagics targeted include species such as dolphinfish, skipjack, blackfin, yellowfin, and king mackerel; and baitfish targeted along the west coast include species such as ballyhoo (Matos-Caraballo and Agar 2011).

Table 3.3.2.1. Target species by coastal region. Source: Matos-Caraballo and Agar (2011).

Percentage of fishermen who target the following species	North Coast	East coast	South coast	West coast	Puerto Rico
Reef fish	88.3%	75.5%	88.0%	64.8%	77.3%
Deepwater snapper	71.6%	71.6%	39.5%	51.3%	55.5%
Pelagic species	65.4%	66.5%	30.0%	26.4%	41.8%
Spiny lobster	27.8%	64.5%	57.1%	47.2%	49.3%
Queen conch	13.0%	34.8%	45.1%	34.6%	33.4%
Baitfish	53.1%	32.9%	30.9%	17.9%	30.7%
Octopus	1.9%	0.0%	19.3%	1.3%	6.0%
Sirajo goby	8.0%	0.0%	0.9%	0.0%	1.7%
Land crab	9.3%	10.3%	6.0%	2.2%	6.0%
Ornamental fish	0.6%	1.9%	0.9%	2.5%	1.6%

Puerto Rico fishermen target multiple species and a variety of species are important to each municipality. Rarely, did more than one to two species account for more than 10% of the landings in a specific municipality, and in many cases the third most important species listed accounted for less than 10% of the landings (Tables 3.3.2.2a-b).

Municipalities located directly along the west coast of Puerto Rico include Aguadilla, Aguada, Rincón, Añasco, Mayagüez, and Cabo Roja. The top species for these west coast municipalities include silk snapper, skipjack tuna, and king mackerel in Aguidilla; silk snapper, skipjack tuna, and king mackerel in Aguada; queen snapper, silk snapper, and dolphin in Rincón; silk snapper, lane snapper, and lobster in Añasco; yellowtail snapper, lane snapper, and king mackerel in Mayagüez; and lobster, boxfishes, and lane snapper in Cabo Roja (Table 3.3.2.2a-b).

Table 3.3.2.2a. Three most important species by municipality, 1999-2003. Percentages of landings by species are included as the numerical value. Source: Griffith et al. (2007).

Municipality	1st Species	2nd Species	3rd Species
San Juan	Yellowtail Snapper 15.0	Jacks 8.0	Lane Snapper 6.4
Cataño	Jacks 7.9	Mojarras 6.9	White Grunt 5.5
Toa Baja	Jacks 7.9	Mojarras 6.9	White Grunt 5.5
Mayagüez	Yellowtail Snapper 12.6	Lane Snapper 11.1	King Mackerel 7.5
Añasco	Silk Snapper 41.0	Lane Snapper 9.6	Lobster 6.0
Rincón	Queen Snapper 28.6	Silk Snapper 25.1	Dolphin 5.1
Ponce	Yellowtail Snapper 18.1	Lane Snapper 13.5	Snappers (generic) 9.1
Juana Díaz	Lobster 32.2	Lane Snapper 17.5	Other fishes 7.5
Santa Isabel	Lane Snapper 22.2	Lobster 9.3	Yellowtail and Mutton Snappers 8.7
Salinas	Lane Snapper 15.7	Yellowtail and Mutton Snappers 9.5	White Grunt/Lobster 9.0
Guayama	Lobster 9.0	White Grunt 8.4	Lane Snapper 8.3
Patillas	Lobster 11.8	Lane Snapper 6.8	Parrotfish 6.0
Arroyo	Parrotfish 15.1	Lobster 10.4	Ballyhoo 7.0
Peñuelas	Lobster 26.0	Hogfish 16.3	Octopus 11.6
Guayanilla	White Grunt 12.1	Mutton Snapper 8.6	Lane Snapper 8.4
Guánica	Lobster 14.0	Yellowtail Snapper 12.0	Hogfish 9.0

Table 3.3.2.2b. Three most important species by municipality continued, 1999-2003.

Municipality	1st Species	2nd Species	3rd Species
Isabela	Lobster 20.7	Nasau Grouper 14.1	Silk Snapper 12.1
Camuy	Yellowtail Snapper 18.1	Mutton Snapper 10.5	King Mackerel 9.2
Arecibo	Silk Snapper 32.9	King Mackerel 8.7	Lobster 8.0
Barceloneta	Silk Snapper 14.3	Triggerfish 8.8	Lane Snapper 7.1
Manatí	Herrings 5.7	White Mullet 5.6	Jacks 4.9
Vega Baja	Silk Snapper 10.2	Red Hind 7.4	Bar Jack 5.7
Vega Alta	Silk Snapper 10.3	Bar Jack 6.4	Red Hind 6.2
Dorado	Silk Snapper 10.0	Triggerfish 6.8	Schoolmaster 6.4
Carolina	Jacks 8.0	White Mullet 7.6	Yellowtail Snapper 7.6
Loíza	Silk Snapper 10.5	Vermilion Snapper 8.5	Yellowtail Snapper 6.6
Rio Grande	Yellowtail Snapper 11.1	Vermilion Snapper 9.9	White Grunt 9.3
Luquillo	White Grunt 10.3	Lane Snapper 7.2	King Mackerel 6.2
Fajardo	Yellowtail Snapper 17.9	Lobster 7.7	King Mackerel 5.4
Ceiba	White Grunt 12.5	Lobster 7.7	Boxfishes 5.4
Vieques	Lobster 15.4	Yellowtail Snapper 8.7	Triggerfish 6.5
Culebra	Nasau Grouper 17.2	Lobster 15.4	Triggerfish 15.1
Naguabo	Lobster 18.7	1st class fish 16.1	3rd class fish 13.7
Humacao	Lobster 13.7	Yellowtail Snapper 9.3	White Grunt 7.8
Yabucoa	Yellowtail Snapper 12.7	Lane Snapper 10.8	White Grunt 10.8
Maunabo	Lane Snapper 12.3	White Grunt 11.9	Lobster 9.3
Lajas	Lobster 8.2	White Grunt 7.8	Lane Snapper 6.5
Cabo Rojo	Lobster 17.8	Boxfishes 9.8	Lane Snapper 6.7
Aguada	Silk Snapper 13.0	Skipjack Tuna 8.5	King Mackerel 7.6
Aguadilla	Silk Snapper 12.9	Skipjack Tuna 10.0	King Mackerel 9.9

Puerto Rico's recreational fishermen range from charter boat captains to individuals who fish with a cane, line and a hook. As of March 9, 2010, there were 582 recreational (including subsistence) fishermen in Puerto Rico registered with the National Angler Registry. As reported in Section 3.3.1.2, a total of 94,000 marine recreational participants embarked on 351,000 fishing trips in 2012. The majority of trips were taken using a private or rental boat (59.5%), followed by shore mode (40%), and charter boat (0.5%, Table 3.3.1.18). Coastal residents made up the majority of participation in the marine recreational sector

(89.3% in 2012); whereas a smaller portion of recreational participation included those from other states (10.7%, Table 3.3.1.19).

Subsistence fishing in Puerto Rico is primarily a working class family activity and they see fish as a source of high quality protein for their family (Griffith et al. 2007). They do differ in some respects from other sectors with regard to key aspects, in that they may often be retired or unemployed (Griffith et al. 2007a). Subsistence fishermen target snapper-grouper species (40%) and pelagic species including species such as dolphin (7.4%) and king mackerel (5.9%), but nearly no shellfish. The varieties of gear used by subsistence fishers are similar to those of recreational fishers; however few use SCUBA gear (Griffith et al. 2007). It is clear that many Puerto Ricans participate in subsistence fishing. However, without more detailed research, it is difficult to know how pervasive this activity is on the island or their household's dependence upon fish as a food source.

Griffith et al. (2007) found that in terms of fishing communities there were both place-based and network-based communities in Puerto Rico. Although fishermen were spread out considerably across the island, there were certain locations that seemed to provide key features of a place-based fishing community including fishing infrastructure and social interactions on a daily basis. Overall, they were able to identify 38 place-based fishing communities on the island (Griffith et al. 2007).

West Coast of Puerto Rico

The southwest corner of Puerto Rico includes a relatively shallow and extended ocean shelf; whereas the ocean floor drops off sharply in the northwest corner. Off the west coast, fishing areas include areas around the islands of Mona, Monito, and Desecho, and deep-water banks such as Bajo de Sico, Tourmaline Bank, and Abrir La Sierra Bank (Matos-Caraballo and Agar 2011).

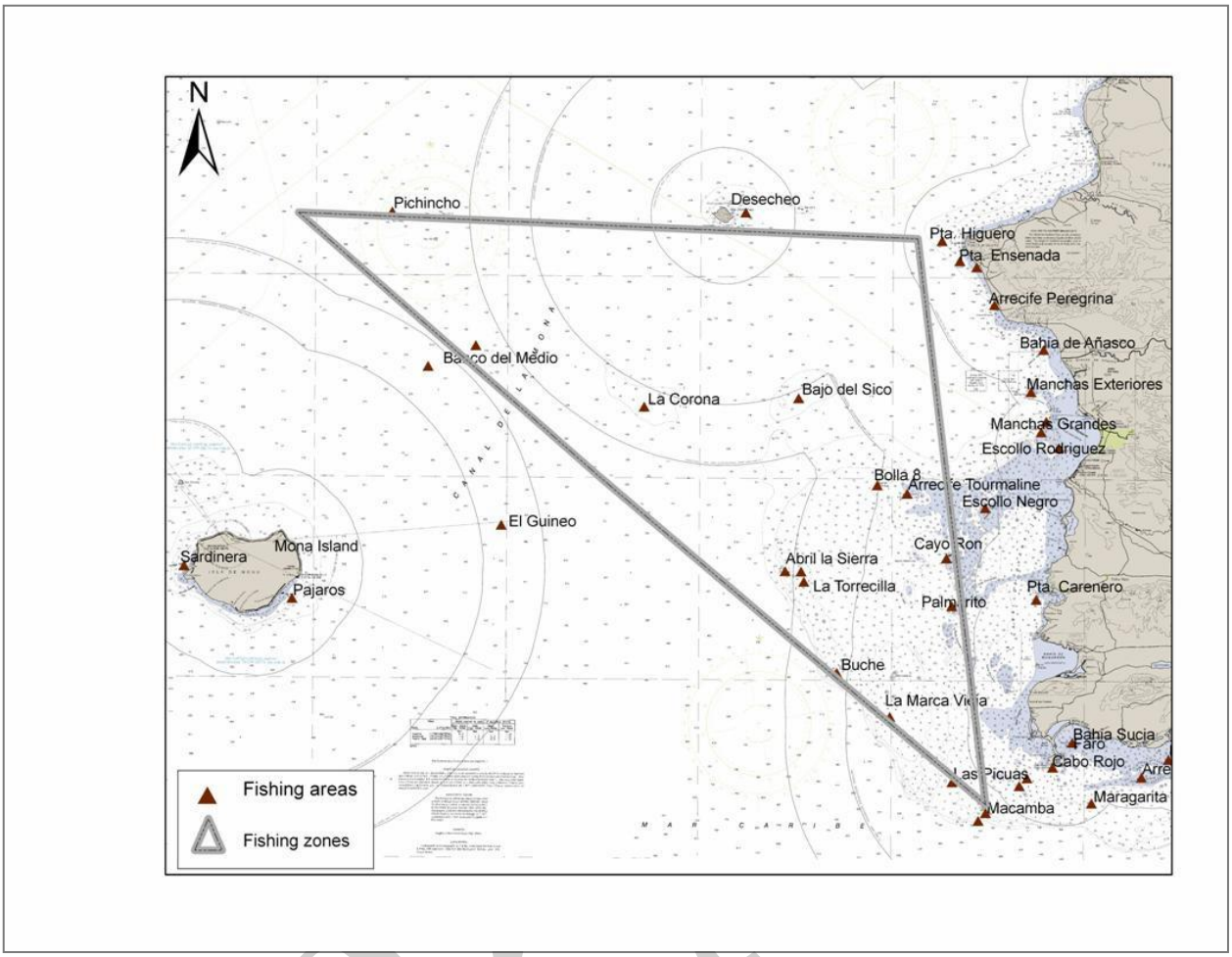


Figure 3.3.2.2. Western fishing territory. Source: Griffith et al. (2007).

The west coast includes the fishing grounds for Puerto Rico's most productive fisheries and some of its most innovative fisheries (Griffith et al. 2007). The western commercial fishing fleet includes a versatile and sophisticated fleet which harvest groupers and snappers from the deep waters of Mona Passage, and divers who come from these and other ports who use scuba tanks and spears to target selective catches (Griffith and Valdés Pizzini 2002). The most important gears used in this region include bottom lines, SCUBA, and to a lesser extent, troll lines and fish pots. The majority of west coast commercial fishing vessels are 10 to 19.9 feet in length (52.5%) and 20 to 29.6 feet in length (44.8%). The average crew size for west coast commercial vessels includes 1.9 crew members (Matos-Caraballo and Agar 2011).

As reported in Section 3.3.1, the west coast accounts for 40% of Puerto Rico's commercial landings. In 2011, ACL units with the largest west coast commercial landings included snapper unit 2 (21.8%), queen conch (14.8%), spiny lobster (11.6%), snapper unit 1 (9.9%), snapper unit 3 (4.3%), groupers (3.4%), snapper unit 4 (2.6%), boxfishes (2.4%), triggerfishes (2.3%) and wrasses (1.5%, Table 3.3.1.11). ACLs with less than 1% of west coast commercial landings included grunts, jacks, parrotfish, porgies, snapper

unit 5, and squirrelfishes. The landings for goatfishes were confidential and cannot be reported. In addition, nearly 23% of west coast landings were comprised of species that are not included in an ACL unit (Table 3.3.1.11).

A recent census of Puerto Rican fishermen included 318 fishermen from the west coast including 217 captains (76% of these licensed fishermen hold full-time licenses, 4% hold part-time licenses, and about 20% hold beginner licenses) and 101 helpers (Matos-Caraballo and Agar 2011).

West coast fishermen are highly dependent on fishing to support their families. A total of 77% of west coast fishermen identify as full-time fishermen. Fishermen also reported that on average, 82.6% of their income was derived from fishing. Commercial fishermen on the west coast have an average of 3.1 dependents including themselves (Matos-Caraballo and Agar 2011). As explained by Matos-Caraballo and Agar (2011), the presence of greater numbers of full-time commercial fishermen in the west coast is due to the higher productivity of the fishing grounds, the long fishing tradition in the area, and limited opportunities for employment outside the fishing industry.

The average age of a west coast commercial fisherman is 47.3 years and the average fisherman has 26.9 years of experience. A very small portion of west coast fishermen (5.7%) reside in a different municipality than where they land their catch (Matos-Caraballo and Agar 2011).

Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank Seasonally Closed Areas

Commercial, recreational, and subsistence landings are not known for the Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank areas. However, as identified in section 3.2.1, dog snapper, schoolmaster snapper, yellowtail snapper, red hind, Nassau grouper, yellowfin grouper, tiger grouper and parrotfish have been known to occur within Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank.

In a recent study, Tonioli and Agar (2009) were able to identify and interview 65 small-scale fishermen who regularly fish in the Bajo de Sico area, in order to elicit information which could be used to provide decision makers with a first-hand account of the reported socio-economic impacts of lengthening the Bajo de Sico seasonal closure. Results from this study are summarized here.

Interviewed fishermen included full-time commercial fishermen (52%), part-time commercial fishermen (40%), charter operators (5%), and subsistence fishermen (3%). Fishermen used a variety of gears including hook and line, bottom line, and longline to target snapper-grouper species. Fishermen reported that their most important species in Bajo de Sico is silk snapper, followed by red hind, and queen snapper. Sixty percent of fishermen fished with only one crew member. About 65% of fishermen derived more than 50% of their household income from fishing.

The 2005 bottom tending gear ban in Bajo de Sico was revealed to have made it more difficult for fishermen to make a living from fishing. Fishermen have been forced to become more reliant on non-fishing occupations because of an increasing number of regulations, higher fuel costs, and declining catches. However, non-fishing jobs are not available or hard to secure, especially because many of the included fishermen already work part-time jobs.

Most fishermen explained that they would not switch gears or target other species if the seasonal closure in Bajo de Sico was extended. They would instead continue to use bottom line, long-line, and hook and line to catch snappers and groupers because switching would be very onerous, given the expense of purchasing new equipment and permits. For the more fishing dependent fishermen (those who rely on fishing for 50-100% of their income), a reduction of 44% of their gross household income is expected if the closure is extended to six months and a reduction of 49% of gross household income is expected if there was a year-round closure in Bajo de Sico. For less fishing dependent fishermen (those who rely on fishing for 0-49% of their income), a reduction of 41% of their gross household income is expected if the closure is extended to six months and a reduction of 45% is expected if there was a year-round closure in Bajo de Sico.

If additional restrictions are place on Bajo de Sico, then Abrir La Sierra Bank and Tourmaline Bank would become fishermen's preferred alternative fishing grounds. Abrir La Sierra Bank and Tourmaline Bank are believed to be showing signs of overexploitation and therefore switching to these areas would be counterproductive. Other important fishing grounds include Pichincho, Corona del Sur, Desecheo, Mona, Gallardo, Macamba, Bajo Medio, Los Placeres, Cabo Engano, and Los Rabos de Isabela.

The simultaneous closure of Bajo de Sico, Tourmaline Bank, and Abrir La Sierra Bank provide fishermen with strong incentive to avoid these areas completely (because of the probability of being detected and fined by the Coast Guard). Extended closures would require fishermen to travel father in search of new aggregations of fish. Fishing trips would become longer, less profitable, and more dangerous because of this. In addition, operating costs (mostly fuel) would increase.

Lengthening the Bajo de Sico closure would force fishermen to become more reliant on other part-time work. Also, the recent siting of additional marine reserves along the west coast of Puerto Rico is resulting in confusion as to when, where, and which species can be harvested.

Placing additional restrictions of Bajo de Sico could impact local fishing communities in several ways including: 1) impacting the entire local harvesting, wholesale, distribution, marketing, retail, and support service chain; 2) through increased operating expenses for fishermen which would be absorbed through lower revenue for captain and crew; 3) through possible weakened kinship relationships (brought about by the lower wages received by crew and resulting requirement to seek additional employment rather than assist the boat owner with tasks such as boat repair); 4) through the reduction in spending at local support businesses such as suppliers of boating and fishing equipment, boat mechanics, ice shops, and fuel

stations (brought about by the lowering of crew's income); 5) impacts to fish cooperatives including fewer employment opportunities, less income, and a possible loss of the market share (restaurants and hotels might seek out cheaper and more readily available seafood imports rather than using local seafood); 6) fishing family stability could be impacted through the inability to provide year-round fresh seafood; and 7) user conflicts could increase (such as crowding) because the amount of fishable grounds would decrease.

Another recent relevant study conducted by Griffith et al. (2007) elicited opinions on the impacts on communities from all MPAs including but not limited to Bajo de Sico, Tourmaline Bank, and Abrir La Sierra Bank. The results of this study relating to the impacts on communities are summarized here. In regard to Tourmaline Bank, over one-third of fishermen who had experience fishing in the MPAs did not agree that the seasonally closed area creates opportunities for employment or investment, but over one-quarter agreed that this was possible (Table 3.3.2.3). Over one-third of fishermen agreed or strongly agreed that the Tourmaline Bank seasonally closed area created problems for their families or themselves, and over half agreed that it created problems for communities (Table 3.3.2.3). These results reflect that restrictions on fishing are liable to hurt families and individuals, but are more probable to hurt communities given the cultural importance of fishing and the importance of seafood for coastal residents.

Table 3.3.2.3. Fishers' opinions regarding Tourmaline Bank's impact on communities (n = 83). Figures are percentages. Source: Griffith et al. (2007).

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
Creates problems for my family and myself	42.7	8.5	11.0	7.3	26.8	3.6
Creates problems for communities	17.1	7.3	14.6	7.3	47.6	5.1
Creates employment/investment opportunity	31.3	5.0	11.3	3.8	25.0	23.9

Results for Bajo de Sico (Table 3.3.2.4) are similar to those for Tourmaline Bank including that a high percentage of fishermen believed that Bajo de Sico closures had detrimental impacts on families and communities, with about one-third indicating that closures were hurting them directly.

Table 3.3.2.4. Fishers' opinions regarding Bajo de Sico's impact on communities (n = 70). Figures are percentages. Source: Griffith et al. (2007).

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
Creates problems for my family and myself	40.0	11.4	12.9	10.0	22.9	2.8
Creates problems for communities	11.4	7.1	20.0	11.4	45.7	4.3
Creates employment/investment opportunity	32.8	4.5	13.4	6.0	23.9	3.0

Results for Abrir La Sierra Bank were also very similar with a high percentage of fishermen who indicated that the seasonal closure had negative impacts on families and communities. Also, one-third indicated that closures in these areas hurt them directly (Table 3.3.2.5).

Table 3.3.2.5. Fishers' opinions regarding Boya 6's/Abrir La Sierra Bank's impact on communities (n = 73). Figures are percentages. Source: Griffith et al. (2007).

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
Creates problems for my family and myself	38.9	12.5	11.3	8.3	25.0	4.2
Creates problems for communities	13.9	8.3	18.1	9.7	45.8	4.2
Creates employment/investment opportunity	21.4	4.3	14.3	4.3	30.0	25.8

3.3.3 Environmental Justice Considerations

Executive Order 12898 requires federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories. This executive order is generally referred to as environmental justice (EJ).

Minority populations: The Hispanic origin group which is considered a minority in the continental United States is the majority ethnic group in Puerto Rico. In the year 2010, 16.3% of the population of the continental United States was comprised of residents that identified as Hispanic or Latino; however for the same year, 99% of the population of Puerto Rico identified as Hispanic or Latino (U.S. Census Bureau, 2010 Census). The minority (minority is commonly interpreted for the United States as White, non-Hispanic) rate for Puerto Rico is substantially higher than that of the continental United States.

Low-income populations: Low-income populations in the Puerto Rico make up a much greater percentage of the general population than in the continental United States. The percentage of people below poverty included 45.2% of the population in Puerto Rico for the year 2010, significantly higher than that of the continental United States which included 15.3% of the population below poverty (U.S. Census Bureau, 2010 Census).

Because these proposed actions are expected to impact fishermen in Puerto Rico and information is not available in most cases to link these fishermen to the communities in which they reside, all communities in Puerto Rico have been examined using census data to see if they have poverty rates that exceed EJ thresholds. However, fishermen located in communities on or near the west coast of Puerto Rico are likely to be more severely impacted by the proposed actions. It can be surmised that these fishermen are more likely to be involved in fishing in the seasonally closed areas of Bajo de Sico, Tourmaline Bank, and Abrir La Sierra Bank.

The threshold for comparison that was used was 1.2 times the average of the Puerto Rico such that, if the value for the community was greater than or equal to 1.2 times the average of the greater area, then the community was considered an area of potential EJ concern (EPA 1999).

As mentioned above, the poverty rate for Puerto Rico for the year 2010 was 45.2%. This value translates into an EJ poverty threshold of approximately 54.2%. The communities below exceeded this poverty threshold and are the most likely to be vulnerable to EJ concerns (Table 3.3.3.1). Communities which exceeded the poverty threshold have been compared to a list of communities located along on the west coast of Puerto Rico and only one community overlaps, Aguada. This community is most likely to be severely impacted by EJ concerns.

Table 3.3.3.1. Puerto Rico communities which exceeded poverty threshold for year 2010. Source: U.S. Census Bureau 2010.

Community	Percent of Population Below Poverty Level
Adjuntas	57.2
Aguada	56.5
Barranquitas	54.7
Ciales	59.3
Coamo	55.8
Comerío	58.4
Corozal	58.4
Guánica	58.2
Guayanilla	56.5
Isabela	57.1
Lajas	55.7
Lares	58.1
Las Marías	58.2
Maricao	65.7
Maunabo	55.6
Moca	57
Morovis	62
Naranjito	55.3
Orocovis	62.6
Patillas	57
Peñuelas	57.7
Quebradillas	60.6
Salinas	58.5
San Sebastián	58.5
Utuado	57.6
Villalba	57.1
Yauco	56.8

The greater commonwealth of Puerto Rico and the majority of the communities expected to be affected by this proposed amendment have minority or economic profiles that include higher rates than that of the continental United States. EJ issues could arise for fishermen relying on species harvested in the seasonally closed areas included in this amendment if access to fishing in these areas becomes more

limited, particularly in regard to poverty. Food insecurity is a large issue in the U.S. Caribbean and these vulnerable low-income populations could be impacted to a greater extent because of their dependence on the fish they receive through fishing efforts in these areas and utilize to supplement their income.

The general participatory process used in the development of fishery management measures (e.g., public hearings, and open Council meetings) is expected to provide opportunity for meaningful involvement by potentially affected individuals to participate in the development process of this amendment and have their concerns factored into the decision process. In addition, the proposed actions section of this amendment will be translated into Spanish to provide local populations with access to the information and the ability to participate in the development of this amendment.

3.3.4 Economic and Social Environment of HMS Fisheries in Puerto Rico

In some ways, the U.S. Caribbean commercial and recreational HMS fisheries operate differently than fisheries that occur off the mainland of the United States. The HMS U.S. Caribbean fisheries are mostly an opportunistic small-scale fishery with few vessels larger than 45 feet in length. In most cases, small-scale fishermen use a multi-gear, multi-fishery approach to target both pelagic and reef fish species, often with the majority of the catch consisting of non-HMS target species (i.e., reef fish species, lobster, conch). These fisheries yield relatively small revenues and/or their seafood processors are small-scale producers. The low number of HMS fishing and dealer permits has resulted in limited catch and landings data for HMS from the U.S. Caribbean fisheries. A description of HMS commercial and recreational fisheries is provided in Section 3.2.4 of this document entitled, "Description of Highly Migratory Species Fisheries."

3.4 Administrative Environment

3.4.1 Federal Fishery Management

Federal fishery management is conducted under the authority of the Magnuson-Stevens Act (16 U.S.C. 1801 et seq.), originally enacted in 1976 as the Fishery Conservation and Management Act. The Magnuson-Stevens Act claims sovereign rights and exclusive fishery management authority over most fishery resources within the U.S. EEZ, an area extending from the seaward boundary of each coastal state to 200 nm from shore, and authority over U.S. anadromous species and continental shelf resources that occur beyond the U.S. EEZ.

Responsibility for federal fishery management decision-making is divided between the Secretary of Commerce (Secretary) and eight regional fishery management councils that represent the expertise and interests of constituent states/territories. Regional councils are responsible for preparing, monitoring, and revising management plans for fisheries needing management within their jurisdiction. The Secretary is

responsible for promulgating regulations to implement proposed plans and amendments after ensuring management measures are consistent with the Magnuson-Stevens Act and with other applicable laws. In most cases, the Secretary has delegated this authority to NMFS.

The Council is responsible for fishery resources in federal waters of the U.S. Caribbean. These waters extend to 200 nm offshore from the nine-mile seaward boundary of the Commonwealth of Puerto Rico and the three-mile seaward boundary of the territory of the USVI. The total area of fishable habitat in the U.S. Caribbean is about 2,467 nm^2 (8,462 km^2). The fishable habitat within the EEZ is 355 nm^2 (1,218 km^2) or 14.39% of the U.S. Caribbean total, with 116 nm^2 (398 km^2) (4.7%) occurring off Puerto Rico and 240 nm^2 (823 km^2) (9.7%), occurring off the USVI. The vast majority of the fishable habitat in federal waters off Puerto Rico is located off the west coast. The vast majority of the fishable habitat in federal waters off the USVI is located off the north coast of St. Thomas. Due to the steep continental slopes that occur off Puerto Rico and the USVI, fishable habitat is defined as those waters less than or equal to 100 fathoms. The majority of fishable habitat occurs in that area, as does the majority of fishing activity for Council-managed species, except for fishing for deep water snappers, which occurs primarily in the EEZ (at depths greater than 100 fathoms).

The Council consists of seven voting members: four public members appointed by the Secretary, one each from the fishery agencies of Puerto Rico and the USVI, and one from NMFS. Public interests are also involved in the fishery management process through participation on advisory panels and through Council meetings that, with few exceptions for discussing personnel matters, are open to the public. In addition, the regulatory process is in accordance with the Administrative Procedures Act, in the form of "notice and comment" rulemaking, which provides extensive opportunity for public scrutiny and comment, and requires consideration of and response to those comments.

Regulations contained within FMPs are enforced through actions of NOAA's Office of Law Enforcement, the U.S. Coast Guard, and various territorial authorities. To better coordinate enforcement activities, federal and territory enforcement agencies have developed cooperative agreements to enforce the Magnuson-Stevens Act. However, enforcement in the Caribbean region is severely underfunded. Because personnel and equipment are limited, enforcement depends largely on voluntary compliance (The Heinz Center 2000).

The Fishery Conservation Amendments of 1990 (P.L. 101-627) conferred management authority for Atlantic HMS, including tunas, oceanic sharks, marlins, sailfishes, and swordfish, to the Secretary from the Fishery Management Councils. For additional information regarding the HMS management process and authority in the Caribbean, please refer to the FMP for Atlantic Tunas, Swordfish, and Sharks (HMS FMP, http://www.nmfs.noaa.gov/sfa/hms/).

Recreational fishing in the EEZ requires fishermen register in the National Registry. For information, please visit the MRIP Web site at http://www.countmyfish.noaa.gov/.

3.4.2 Commonwealth and Territory Fishery Management

The governments of the Commonwealth of Puerto Rico and the Territory of the USVI have the authority to manage their respective state fisheries. As a Commonwealth, Puerto Rico has an autonomous government, but is voluntarily associated with the U.S. The USVI is an unincorporated territory with a semi-autonomous government and its own constitution (OTA 1987).

Puerto Rico has jurisdiction over fisheries in waters extending nine nm from shore. Those fisheries are managed by Puerto Rico's Department of Natural and Environmental Resources. Section 19 of Article VI of the Constitution of Puerto Rico provides the foundation for the fishery rules and regulations. Puerto Rico's Law 278 of 1998 establishes public policy regarding fisheries.

The USVI has jurisdiction over fisheries in waters extending three nm from shore, with the exception of about 5,650 acres of submerged lands off St. John which are owned and managed by the National Park Service (Goenaga and Boulon 1991). The USVI Department of Planning and Natural Resources is the USVI's fishery management agency.

Each state fishery management agency has a designated seat on the Council. The purpose of local government representation at the Council level is to ensure local participation in federal fishery management decision-making. The state governments have the authority to manage their respective state fisheries. Each of the states exercises legislative and regulatory authority over their natural resources through discrete administrative units. Although each agency is the primary administrative body with respect to the state's natural resources, both Puerto Rico and the USVI cooperate with numerous state and federal regulatory agencies when managing marine resources.

Both Puerto Rico and the USVI require commercial fishing licenses, permits for some species, and reporting. Puerto Rico requires a license for commercial fishers, and has categories for full-time, part-time, novice, and non-resident commercial fishers, ornamental fisheries, and owners of rental boats, including charter and party/head boats. Additional commercial permits are required for the harvest of spiny lobster, queen conch, common land crab, incidental catch, and sirajo goby (i.e., ceti) fisheries. Puerto Rico also requires a license for all recreational fishermen 13 years and older (excluding fishermen on charter or head boats); however this requirement has not been enforced yet. Additional recreational permits are required for the harvest of spiny lobster, queen conch, common land crab, billfish (HMS), freshwater shrimp, and sirajo goby.

The USVI only has a license requirement for commercial fishers who are permanent USVI residents, with the exception of a recreational shrimp permit for Altona Lagoon and Great Pond on St. Croix, and for fishing activities in the Great St. James Marine Reserve off St. Thomas. The USVI government is currently developing recreational fishing regulations for the Territory.

Additional information regarding fishery management in state or federal waters can be found in the 2010 Caribbean ACL Amendment (CFMC 2011a).

3.4.3 Atlantic Highly Migratory Species

Atlantic tunas, billfish, and swordfish are managed under the dual authority of the Magnuson-Stevens Act and the Atlantic Tunas Convention Act (ATCA), which authorizes Secretary to promulgate regulations as may be necessary and appropriate to implement recommendations of the ICCAT. Federal Atlantic shark fisheries are managed under the authority of the Magnuson-Stevens Act. The authority to issue regulations under the Magnuson-Stevens Act and ATCA has been delegated from the Secretary to the Assistant Administrator for Fisheries, NOAA. On May 28, 1999, NMFS published in the *Federal Register* (64 FR 29090) final regulations, effective July 1, 1999, implementing the FMP for Atlantic Tunas, Swordfish, and Sharks (1999 FMP) and Amendment 1 to the Atlantic Billfish FMP (Billfish FMP). On October 2, 2006, NMFS published in the *Federal Register* (71 FR 58058) final regulations, effective November 1, 2006, implementing the 2006 Consolidated Atlantic HMS FMP, which consolidated and contained the management measures for all Atlantic HMS fisheries. The implementing regulations for the Consolidated Atlantic HMS FMP and its amendments for Atlantic HMS are at 50 CFR §635.

Chapter 4. Environmental Effects

Chapter 4 describes the anticipated effects to the physical, biological, economic, social, and administrative environment deriving from each of the alternatives presented in Chapter 2**.**

4.1 Action 1: Modify the Length of the Closed Fishing Season

4.1.1 Direct and Indirect Effects on the Physical Environment

Alternative 1 is the no action alternative and would not result in any change to the length of the fishing season presently established for each of the three managed areas. As a result, no additional direct or indirect effects on the physical environments of Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank can be expected. Management actions that affect the physical environment mostly relate to the interactions of fishing gear with the sea floor. As described in Section 3.1, the sea floor in the three subject areas supports extensive coral reefs. Under the status quo, the potential for fishing activities to damage these coral reefs (including Endangered Species Act (ESA)-listed species) would be unchanged. The important coral habitats that characterize these three areas would continue to be at risk of fishing line entanglements and other gear interactions without change. Maintaining the current regulations would not enhance direct benefits to the physical environment and may, in fact, lead to declines of the physical environment (especially reef building corals) as important reef processes are interrupted due to fishing activities and associated gear impacts. The ability of the coral reef community to flourish, and to maintain the habitat that characterizes these areas (García-Sais et al. 2007; García-Sais et al. 2010), likely will suffer from these impacts. Without healthy coral populations, the associated reef ecosystem likely will decline, ultimately indirectly affecting the biological and ecological environment by reducing biodiversity, altering essential fish habitat, and potentially destabilizing the various reef fish spawning aggregations that have been described from these areas (García-Sais et al. 2007; García-Sais et al. 2010; García-Sais et al. 2013).

Alternative 2 would decrease protection to coral habitats, including ESA-listed species and important mesophotic reefs, in Bajo de Sico by reducing the closed season for that area from six months to three months. As described for **Alternative 1**, benthic habitats would be at increased risk of entanglements and other harmful interactions with fishing gear, resulting in direct negative effects on the physical environment of Bajo de Sico.

Both **Preferred Alternative 3** and **Alternative 4** would increase the closed season to six months in either Abrir La Sierra Bank or Tourmaline Bank, or both, increasing the level of physical habitat protection afforded these two areas to be equivalent to that provided in Bajo de Sico. In contrast to **Alternative 2**, a

longer closed season would result in more safeguards to the benthic habitats of Abrir La Sierra Bank and Tourmaline Bank and would maintain the level of protection presently afforded Bajo de Sico, thus resulting in positive short-term and long-term direct impacts.

When compared to **Preferred Alternative 3**, **Alternative 4** would provide greater protection to the physical environment because **Preferred Alternative 3** prohibits specified fishing activities during the time of year in which the weather creates poor fishing conditions. During this time of year, fishers may not fish within the managed areas as frequently due to weather constraints. **Alternative 4** would provide protection during better weather months, providing additional protection during months that are typically fished. Similarly, according to Griffith et al. (2007), March through August are the busiest months for recreational fishing in Puerto Rico. **Alternative 4** would provide protection for a portion of the busy recreational season, thus providing better protection to habitat as compared to **Preferred Alternative 3**.

While **Alternative 2, Preferred Alternative 3,** and **Alternative 4** would provide some protection for part of the year, benthic habitat would remain vulnerable to fishing gear interactions for six or more months of the year. Resultant damage could require years for recovery, if recovery occurs at all. These coral populations are sensitive, vulnerable, and slow growing, so chronic impacts resulting from even six months of exposure to gear impacts would likely have long-term indirect impacts on the physical environment. Such declines in coral health would be expected to result in declines to both essential fish habitat (EFH) and biodiversity, and may negatively impact reef fish spawning aggregations that are known to occur in these areas.

Alternative 5 would provide the greatest direct and indirect benefits to the physical environments (including ESA-listed species) because it would provide year-round protection to habitats from interactions with fishing gear. Vessels would be prohibited from specified fishing activities, thus greatly reducing the likelihood of damaging interactions between the benthic habitat and fishing gear.

4.1.2 Direct and Indirect Effects on the Biological/Ecological Environment

Alternative 1 is the no action alternative and would not result in any change to the length of the fishing season presently established for each of the three managed areas. As a result, no additional direct or indirect effects on the biological or ecological environments of Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank can be expected. In interviews conducted when the Caribbean Fishery Management Council (Council) was modifying the Bajo de Sico closed season, fishers stated that if those proposed regulations were implemented for Bajo de Sico, then Abrir La Sierra Bank and Tourmaline Bank would become their preferred fishing grounds (Tonioli and Agar 2009). Those proposed regulations were implemented (CFMC 2010). Thus, as long as the current regulations are maintained for these three areas, including the more restrictive closure provisions established for Bajo de Sico in 2010, reef fish species within Abrir La Sierra Bank and Tourmaline Bank will continue to experience increased fishing pressure at least in October, November, and March each year, due to effort shifting from Bajo de Sico. Following

establishment of seasonal closures in all three of these areas, Marshak and Appeldoorn (2008) observed noticeable increases in fishing effort within these protected areas during the non-closure period, providing evidence that effort shifting is occurring in these areas. This increase in effort may have overridden any positive impacts that the extension of the Bajo de Sico seasonal closure may have otherwise produced (Marshak and Appeldoorn 2008).

A number of studies have investigated spawning patterns and documented the occurrence of spawning aggregations of various species within the three managed areas (Table 4.1.2.1). Direct and indirect effects stemming from the choice of a closed season for fishing activities in Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank will be strongly influenced by these spawning patterns and associated spawning aggregations. It is well established that spawning aggregations result in localized but very high densities of the aggregating species, rendering the fish extremely vulnerable to fishing activities (Schärer et al. 2009a). As outlined in Chapter 1, some examples of species known to occur in the three areas are Nassau grouper, red hind, yellowfin grouper, yellowmouth grouper, and dog snapper.

Kobara et al. (2013) found that Nassau grouper (*Epinephelus striatus*) in the Caribbean form spawning aggregations from December to March when water temperature cools to less than about 27°C. However, other studies have found slightly different spawning patterns. According to Schärer-Umpierre et al. (2013), the reported time of Nassau grouper spawning has traditionally been from November to February. The most recent passive acoustic data collected by Appeldoorn and Schärer-Umpierre (unpublished manuscript) in Bajo de Sico documented Nassau grouper reproductive activity occurring from January through April. Concordant data from underwater visual surveys identified at least two peaks in spawning activity during February and March, with continued presence into April at Bajo de Sico (Appeldoorn and Schärer-Umpierre unpublished manuscript).

Red hind (*Epinephelus guttatus*) spawn within a specific time period surrounding the full moon in December to March (Sadovy et al., 1994; Schärer et al. 2009a; Rowell et al. 2010; Rowell et al. 2012). Preliminary review of passive acoustic data collected in 2013 by Appeldoorn and Schärer-Umpierre (unpublished manuscript) indicates the presence of reproductively active red hind at Abrir La Sierra Bank into the second week of March, when the current closed season had already ended.

Abundant research indicates yellowfin grouper (*Mycteroperca venenosa*), and yellowmouth grouper (*M. interstitialis*) aggregate between February and May (Schärer et al. 2009a; Rowell et al. 2012; Appeldoorn and Schärer-Umpierre unpublished manuscript). Dog snapper are reported to spawn throughout the year off Cuba (García-Cagide et al. 1999). A Caribbean study collected ripe females in February-March, and one ripe female and one spent male in November (Thompson and Munro 1974a). In the northeastern Caribbean, individuals in spawning condition have been observed in March (Erdman 1976).

Yellowtail snapper spawning extends over a protracted period, peaking at different times in different areas (Allen 1985; Figuerola and Torres 1997). Figuerola and Torres (1997) report that, in the U.S. Caribbean, the reproductive season of this fish extends from February to October, with a peak from April to July.

Table 4.1.2.1: Spawning periods for species occurring in Abrir La Sierra Bank, Bajo de Sico, or Tourmaline Bank

Species	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Dog Snapper	X	X	X	X	X	X	X	X	X	X	X	X
Nassau Grouper	X	XX	XX	X							X	X
Red Hind	X	X	X									X
Yellowfin Grouper		X	X	X	X							
Yellowmouth Grouper		X	X	X	X							
Yellowtail Snapper		X	X	XX	XX	XX	XX	X	X	X		

X=spawning occurs; XX=Known spawning peak

Alternative 1 is likely to perpetuate the existing level of risk for interactions between ESA-listed species and the reef fish and spiny lobster fisheries in the U.S. Caribbean.

Alternative 2 would reduce the extent of the Bajo de Sico seasonal closure from its present October 1-March 31 period to a December 1-last day of February period. Compared to the other alternatives, including the status quo, this alternative would result in fewer benefits to the biological and ecological environments. This shorter closure period would reduce the level of protection afforded spawning aggregations of many species (see Table 4.1.2.1), resulting direct negative effects to the aggregating species and indirect negative effects to other species that occur in the areas but have not been reported to aggregate to spawn within Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. The effects of reducing the length of the closed season on sea turtles are unclear. If **Alternative 2** causes an increase in overall fishing effort, it may increase the risk of interactions between the fisheries and sea turtles. Conversely, if the reduction in the season simply shift existing effort from one area to another, but does not increase it overall, the biological impacts to sea turtles may be very similar to **Alternative 1**. **Alternative 2** is likely to be less biologically beneficial to *Acropora* than **Alternative 1**. **Alternative 2** would increase the likelihood of interactions between *Acropora* with fishermen.

Preferred Alternative 3 would modify the closed seasons for Abrir La Sierra Bank and Tourmaline Bank from December 1- last day of February to October 1-March 31. Under **Preferred Alternative 3**, Abrir La Sierra Bank (**Preferred Sub-Alternative 3a**) and/or Tourmaline Bank (**Preferred Sub-Alternative 3b**) would be closed to specified fishing activities during all the applicable species-specific exclusive economic zone (EEZ) seasonal closures described in section 2.1, with the exception of the entire April-June closure for mutton and lane snappers and the last month (April) of the closure for red, black, tiger, yellowfin, and yellowedge groupers. As a result of the additional seasonal closures, **Preferred Alternative 3** will have a direct positive impact, outside of their already established closed

seasons, for these species. Lane and mutton snapper fisheries are currently closed, from April 1 through June 30, within the federal waters for which additional closures are proposed. If that separate seasonal closure is continued, **Preferred Alternative 3** will extend the time when fishing for those species is prohibited within the designated areas, potentially providing greater protection by reducing fishing mortality. In addition to the current closure, fishing for lane and mutton snappers will be prohibited from October 1 through March 31, creating a fishing closure for those two species of October 1 through June 30 within Abrir La Sierra Bank and the federal portions of Bajo de Sico, and Tourmaline Bank. Similarly, **Preferred Alternative 3** coupled with the current closure of fisheries for red, black, tiger, yellowfin, and yellowedge groupers would provide two more months (October and November) of protection for those species, prohibiting fishing from October 1 through April 30 within the management areas. **Preferred Alternative 3** would also provide indirect protection to any potentially aggregating snapper or grouper species by prohibiting fishing with gear likely to result in the harvest of such species during the months aggregations are known or predicted to be present (Table 4.1.2.1). If **Preferred Alternative 3** reduces the overall fishing effort, it may decrease the risk of interactions between fishermen and sea turtles. Conversely, if the increased length of the seasonal closure simply shift existing effort from one area to another, but does not decrease it overall, the biological impacts to sea turtles may be very similar to **Alternative 1**. **Preferred Alternative 3** is likely to be more biologically beneficial to *Acropora* than **Alternatives 1** and **2**. **Preferred Alternative 3** would decrease the likelihood of interactions between *Acropora* with fishermen.

Alternative 4 would modify the closed season of Abrir La Sierra Bank (**Sub-Alternative 4a**), Bajo de Sico (**Sub-Alternative 4b**), and Tourmaline Bank (**Sub-Alternative 4c**) to December 1-May 31. Except for **Alternative 5** (year-round closure), this alternative would provide the greatest direct and indirect benefits to the biological and ecological environments. In addition to the added protection of the seasonal species-specific closures as described in section 2.1, this alternative would encompass the largest number of identified spawning aggregations (Table 4.1.2.1). While there are still some known aggregations outside this time period, **Alternative 4** protects each species identified in Table 4.1.2.1 for the majority of its spawning period. With respect to sea turtles, the biological impacts of **Alternative 4** are likely to be similar to those described for **Preferred Alternative 3**. With respect to *Acropora*, the biological benefits of from this alternative are likely to be greater than **Preferred Alternative 3**.

Alternative 5 would establish a year-round closure in Abrir La Sierra Bank (**Sub-Alternative 5a**), Bajo de Sico (**Sub-Alternative 5b**), and Tourmaline Bank (**Sub-Alternative 5c**), thereby providing the greatest protection to the biological and ecological environments specified in Actions 2 (Council-managed reef fish), 3 (spiny lobster), and 5 (highly migratory species; HMS). With a year-round closure, all species will be fully protected, even outside their species-specific EEZ closures. With respect to sea turtles, the biological impacts of **Alternative 5** are likely to be similar to those described for **Preferred Alternative 3** and **Alternative 4**. With respect to *Acropora*, this alternative is likely to be the most biologically beneficial relative to all other alternatives.

4.1.3 Direct and Indirect Effects on the Economic Environment

The purpose of this amendment is to establish consistent regulations for the three managed areas in order to ensure protection of spawning aggregations of reef fish and the benthic habitat supporting those aggregations. The benthic habit, some of it deepwater corals, also serve as residential, recruitment, and foraging habitat for a variety of species. There is also a need to modify the seasonal closures to ensure continued and consistent provision of the important ecological services they provide (recruitment, residential, foraging, and spawning aggregation habitats for commercially and recreationally important reef fish and shellfish). It is also important to establish consistency among the three managed areas to facilitate enforcement and avoid confusion among constituents.

As such, the goal of this action is not to reduce total harvest of any species, or in total. The economic effects are indirect and are largely beneficial due to the future economic benefits associated with protecting spawning aggregations, reducing habitat damage, and reducing/eliminating regulatory confusion/inconsistency. Protection of spawning aggregations is expected to result in healthier stocks that could increase annual catch limits (ACLs) and commercial and recreational harvest and revenues in the future. Reduction in habitat damage is expected to increase spawning areas and stock health. Reduction/elimination of regulatory confusion due to inconsistencies is expected to improve enforcement capability and the ability of fishermen to abide by regulations. This better enables protection of the three managed areas and leads to healthier stocks.

Because no reduction in allowable harvest is proposed, total short-term revenue may not be reduced, only temporally altered under Action 1. Some short-term disruption of fishing behavior might occur as commercial and recreational fishermen adjust to new regulations. However, the longer-term gains from healthier stocks and potential increases in the ACLs in the future would be expected to exceed/mitigate the short-term losses that might occur. In order to reach this outcome, however, timing of closures needs to be right for the resource(s), and regulatory consistency for consistencies sake may not be justified. That is, the closures need to be biologically beneficial in order to expect beneficial economic effects from regulatory consistency.

In general, a longer closed season is expected to potentially result in short-term adverse economic effects for fishermen due to potential lower landings and revenues if fishermen are unable to adjust their fishing effort. But also, in general, long-term economic benefits would likely result from decreased fishing effort, habitat damage from anchoring, and gear interactions with the habitat. Healthier coral communities can provide fish stocks with more habitat and protection and, ultimately, healthier stocks, higher landings and higher revenues from fishing. These long-term benefits outweigh the short-term adverse economic effects.

Inconsistencies in regulations between the three managed areas could have negative economic effects while consistency among regulations could have the opposite effect, but only if there are biological

benefits to doing so. In none of these circumstances can the economic effects be quantified due to a lack of landings data from these managed areas. The areas are on a smaller scale than data reporting. However, because all three managed areas are located on the West Coast of Puerto Rico, trips, landings, and ex-vessel revenue information is reported in Chapter 3 for the West Coast. ACL unit, species specific, and gear usage information related to landings and revenues is also provided when possible.

Under **Alternative 1 (No Action)**, two of the three managed areas (Abrir La Sierra Bank and Tourmaline Bank) would remain closed for three months from December 1 to the last day of February. Bajo de Sico would remain closed for six months from October 1 to March 31. Under **Alternative 1 (No Action)**, there is confusion about regulations between the three areas among the fishing public and enforcement personnel. This threatens the ability of enforcement to protect the managed areas from fishing activities during closed seasons and results in potential damage to coral reefs from anchoring and gear interactions with coral communities. The confusion over regulatory inconsistencies would continue under **Alternative 1 (No Action)** and thereby threaten the conservation goals set for the three managed areas. Subsequently, this would result in potentially lower long-term economic benefits than might otherwise be possible.

Alternative 2 proposes that Bajo de Sico be closed from December 1 to the last day of February instead of October 1 to March 31 under **Alternative 1 (No Action)**. The resulting increased fishing season due to a shorter closure in Bajo de Sico than under **Alternative 1** is expected to increase short-term economic benefits for fishermen (from increased landings and subsequent revenues). However, decreases in long-term economic benefits (from potential decreases in fishing stocks from less healthy benthic habitats) are also expected. That is, the long-term adverse economic effects from a shorter closure override the potential short-term economic gains under **Alternative 2**. Other than **Alternative 5**, **Alternative 2** is the least economically beneficial alternative for Bajo de Sico. **Sub-alternative 4b**, which proposes a December 1 to May 31 closure ranks in between these two alternatives.

Preferred Alternative 3 has two sub-alternatives. **Preferred Sub-alternative 3a** proposes a six month closure for Abrir La Sierra Bank rather than the three month closure under **Alternative 1 (No Action)**. A longer closure for Abrir La Sierra Bank is expected to result in some short-run economic adverse effects from potentially less landings and ex-vessel revenues for fishermen. However, long-run economic benefits are also expected in the form of less fishing activity that may result in damage from anchoring and gear interactions. These long-run benefits outweigh the potential short-term adverse economic effects. Other than **Alternative 5**, this (**Preferred Sub-alternative 3a**) or **Sub-alternative 4a** (also a six month closure) is the next most economically beneficial alternative for Abrir La Sierra Bank. The timing of spawning aggregations and other biological occurrences will need to be weighed to determine which alternative is most biologically and consequently more economically beneficial.

Preferred Sub-alternative 3b proposes that Tourmaline Bank be closed from October 1 to March 31, which is three months longer than under **Alternative 1 (No Action)**. This is expected to result in short-

term economic adverse effects but long-run economic benefits that exceed the short-term drawbacks. Other than **Alternative 5**, this (**Preferred Sub-alternative 3b**) or **Sub-alternative 4c** (also a six month closure but extends from December 1 to May 31) is the next most economically beneficial alternative for Tourmaline Bank. The timing of spawning aggregations and other biological occurrences will need to be weighed to determine which alternative is most biologically and consequently more economically beneficial.

Alternative 5 has three sub-alternatives. **Sub-alternatives 5a**, **5b**, and **5c** propose year-round closures for all three managed areas. This set of **Alternative 5** sub-alternatives are expected to potentially have the greatest short-run economic negative effects for fishermen in the form of decreased landings and revenues compared to the other alternatives under Action 1. Approximately 40% of landings and ex-vessel revenue from fishing in Puerto Rico is attributed to the West Coast. As stated above and in Chapter 3, these potential changes in landings and ex-vessel revenues cannot be quantified due to a lack of retention in the three managed areas. While short-run economic effects are most likely negative due to the possible inability of fishermen to adjust to new fishing areas quickly enough to make up for changes in landings, these three **Alternative 5** sub-alternatives would also likely have the highest long-run economic benefits compared to all other alternatives under Action 1.

With regard to length of closures, a longer closure is more economically beneficial. **Alternative 5** (if all sub-alternatives are chosen), which offers a year-round closure for all areas would yield the greatest economic benefits followed by **Preferred Alternative 3** and **Alternative 4** (if all sub-alternatives are chosen), which offer six- month closures for all areas. **Preferred Alternative 3** and **Alternative 4** rank equally although one could be more beneficial than the other depending on biological benefits. **Alternative 1** is the next most economically beneficial while **Alternative 2** is the least economically beneficial.

With regard to consistency in regulations between the three managed areas, choosing **Alternative 2**, or all sub-alternatives under **Preferred Alternative 3**, **Alternative 4**, or **Alternative 5** would result in consistency in closure times between the three managed areas. Each of these would better enable enforcement to enforce regulations and the public to abide by them and result in long-term economic benefits.

4.1.4 Direct and Indirect Effects on the Social Environment

Effects from fishery management changes on the social environment are difficult to analyze due to complex human-environment interactions and a lack of quantitative data about that interaction. Generally, social effects can be categorized according to changes in: human behavior (what people do), social relationships (how people interact with one another), and human-environment interactions (how people interact with other components of their environment, including enforcement agents and fishery

managers). It is generally accepted that a positive correlation exists between economic effects and social effects. Thus, in Section 4.1.3, alternatives predicting positive or negative economic effects are expected to have correlating positive or negative social effects.

This action would directly impact commercial, recreational, and subsistence fishermen who fish for Council-managed species in Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. Enforcement agents responsible for enforcing regulations in these areas would also be directly impacted. In addition, fishermen who don't fish in these seasonally closed areas, but depend on species which occur in these areas and are protected during the closures, could be indirectly impacted by this action.

Alternative 1 (No Action) would retain the current closed seasons for Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. Under **Alternative 1 (No Action)** the closed seasons for these three areas would continue to be inconsistent. Both Abrir La Sierra Bank and Tourmaline Bank would continue to be closed to specific fishing activities (fishing for all species including HMS is prohibited in both areas) from December 1 to the last day of February, each year. Whereas, Bajo de Sico would remain closed to specific fishing activities (fishing for or possession of Council-managed reef fish species is prohibited) from October 1 to March 31, each year. These inconsistent closed seasons exist alongside other seasonal closures for specific species within the EEZ including: 1) a seasonal closure for red, black, tiger, yellowfin, and yellowedge groupers from February 1 through April 30; 2) a seasonal closure for vermilion, black, silk, and blackfin snapper from October 1 through December 31; and 3) a closure for lane and mutton snapper from April 1 through June 30. The continuation of inconsistent closed seasons under **Alternative 1 (No Action)** for Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank could contribute to a continued difficulty in enforcing regulations in these areas because of the varying closed seasons which is also likely compounded by other closed seasons for specific species (as listed above). In addition, the continuation of inconsistent closed seasons for Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank could contribute to a continued difficulty for fishermen in understanding when and where fishing is allowed.

Impacts of the current closed seasons for Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank under **Alternative 1 (No Action)** likely include the impacts to fishing communities described by fishermen in section 3.3.2. Over half of fishermen (54.9% of those interviewed regarding Tourmaline Bank, 57.1% for Bajo de Sico, and 55.5% for Abrir La Sierra Bank, Tables 3.3.2.3-5) stated that these closures create problems for communities. About one-third of fishermen (34.1% for Tourmaline Bank, 32.9% for Bajo de Sico, and 33.3% for Abrir La Sierra Bank, Tables 3.3.2.3-5) stated that these areas create problems for their families and themselves.

As stated in Section 4.1.2, in 2010, regulations prohibiting fishing for or possession of Council-managed reef fish were implemented in Bajo de Sico. Prior to implementation of that action, fishermen were interviewed to elicit their opinions regarding the possible impacts of placing additional restrictions on fishing in Bajo de Sico. These impacts are detailed in section 3.3.2. One forecasted outcome included the

shifting of fishing effort to Tourmaline Bank and Abrir La Sierra Bank. Therefore, it is likely that reef fish fishermen have shifted their effort to the other two areas of Tourmaline Bank and Abrir La Sierra Bank during the closed season in Bajo de Sico. In addition, as reported in Section 4.1.2, there has been an observable increase in fishing effort within all three protected areas during the open seasons. Therefore, it is likely that under **Alternative 1 (No Action)** these status quo harvest patterns would remain, with increased effort in Tourmaline Bank and Abrir La Sierra Bank during October, November, and March (for reef fish during Bajo de Sico's closed season) and increased fishing effort in all three seasonally closed areas during the open periods.

Alternative 2 would modify the closed season for Bajo de Sico to December 1 through the last day of February. Under **Alternative** 2, the closed season for federal waters in Bajo de Sico would be consistent with the closed seasons for Abrir La Sierra Bank and Tourmaline Bank. These consistent regulations would likely benefit enforcement agents, as it could be easier to enforce consistent regulations in all areas. In addition, the compatibility of regulations could benefit fishermen as it could help contribute to an ease in understanding when and where fishing is allowed. Consistenty of closed seasons for federal waters under **Alterntiave 2** could also benefit the resource. This could occur because of an ease in enforcement and a better understanding by fishermen as to when the areas are closed. Thus, it could be likely that less prohibited fishing would occur in these areas during the consistent closed seasons. These benefits to the resource (such as stronger stocks, more fish, and healthier habitat) could positively benefit fishermen.

Under **Alternative 2**, the closed season for Bajo de Sico would be reduced from six months to three months. This reduction in length of the closed season would likely be directly beneficial for reef fish fishermen who fish in Bajo de Sico. A total of 65 fishermen were interviewed by Tonioli and Agar (2009) prior to the implementation of the six month closure for Bajo de Sico and these fishermen commonly fished with one crew member; therefore it is likely that at least 130 fishermen could be positively impacted by the reduction in season length for Bajo de Sico under **Alternative 2**. Under **Alternative 2**, these fishermen would be able to fish for reef fish for three more months in Bajo de Sico than under **Alternative 1 (No Action)**.

As described in Section 3.3.2, the community impacts of placing additional restrictions (such as the lengthening of the seasonal closure and the addition of the prohibition of Council-managed reef fish during the closed season in Bajo de Sico, which were implemented by Regulatory Amendment 3 and currently exist under **Alternative 1 (No Action)**) include: 1) impacting the entire local harvesting, wholesale, distribution, marketing, retail, and support service chain; 2) increased operating expenses for fishermen which would be absorbed through lower revenue for captain and crew; 3) possible weakened kinship relationships (brought about by the lower wages received by crew and resulting requirement to seek additional employment rather than assist the boat owner with tasks such as boat repair); 4) reduction in spending at local support businesses such as suppliers of boating and fishing equipment, boat mechanics, ice shops, and fuel stations (brought about by the lowering of crew's income); 5) impacts to fish cooperatives including fewer employment opportunities, less income, and a possible loss of the

market share (restaurants and hotels might seek out cheaper and more readily available seafood imports rather than using local seafood); 6) fishing family stability could be impacted through the inability to provide year-round fresh seafood; and 7) user conflicts could increase (such as crowding) because the amount of fishable grounds would decrease. Under **Alternative 2**, some of these negative community impacts could be reversed or are likely to be less severe than under **Alternative 1 (No Action)**. The modification of the closed season for Bajo de Sico to December 1 through the last day of February under **Alternative 2** would likely benefit communities and fishermen.

Conversely, the reduction in the closed season in Bajo de Sico by three months under **Alternative 2** could also impact fishermen dependent on reef fish (including those who fish in Bajo de Sico and those who do not) in the long-term because the resource would be protected for three fewer months than under **Alternative 1 (No Action)**. This could negatively impact these fishermen because the reef fish resource would not receive the intended benefits (such as stronger stocks, more fish, healthier habitat) as it would under **Alternative 1 (No Action)**.

Preferred Alternative 3 would modify the closed seasons for Abrir La Sierra Bank and Tourmaline Bank to October 1 through March 31 if **Preferred Sub-Alternatives 3a** and **3b** are selected. If both **Preferred Sub-Alternatives 3a** and **3b** are selected, the closed seasons for Abrir La Sierra Bank, Tourmaline Bank, and Bajo de Sico would be consistent. These consistent regulations would likely benefit enforcement agents, as it would likely be easier to enforce consistent regulations in all three areas. The compatibility of Federal regulations between Abrir La Sierra Bank, Tourmaline Bank, and Bajo de Sico could benefit fishermen as it could help contribute to an ease in understanding when and where fishing is allowed. However, if only one sub-alternative is selected then these positive effects would likely not occur because regulations would remain inconsistent.

Under **Preferred Sub-Alternatives 3a** and **3b** the closed seasons for Abrir La Sierra Bank and Tourmaline Bank would be lengthened by three months respectively. This increase in the length of the closed season would likely be negative for fishermen who depend on fishing for species in Abrir La Sierra Bank and Tourmaline Bank.

The negative impacts to fishermen and fishing communities under **Preferred Sub-Alternatives 3a** and **3b** could include those detailed in Section 3.3.2 including: 1) impacts to the entire local harvesting, wholesale, distribution, marketing, retail, and support service chain; 2) increased operating expenses for fishermen which would be absorbed through lower revenue for captain and crew; 3) possible weakened kinship relationships (brought about by the lower wages received by crew and resulting requirement to seek additional employment rather than assist the boat owner with tasks such as boat repair); 4) reduction in spending at local support businesses such as suppliers of boating and fishing equipment, boat mechanics, ice shops, and fuel stations (brought about by the lowering of crew's income); 5) impacts to fish cooperatives including fewer employment opportunities, less income, and a possible loss of the market share (restaurants and hotels might seek out cheaper and more readily available seafood imports

rather than using local seafood); 6) fishing family stability could be impacted through the inability to provide year-round fresh seafood; and 7) user conflicts could increase (such as crowding) because the amount of fishable grounds would decrease. In addition, the lengthening of the seasonal closure as proposed under **Preferred Sub-Alternatives 3a** and **3b** for Abrir La Sierra Bank and Tourmaline Bank respectively could require fishermen to travel farther to search for new aggregations of fish. This could decrease the profitably of fishing trips and make trips more dangerous. Also, fuel costs could increase and fishermen could be forced to become more reliant on non-fishing occupations.

Conversely, the lengthening in the closed season in Abrir La Sierra Bank and Tourmaline Bank by three months under **Preferred Sub-Alternatives 3a** and **3b** could also impact fishermen (including those who fish in Bajo de Sico and those who do not) in the long-term because the resource would be protected for three more months than under **Alternative 1 (No Action)** or **Alternative 2**. This could positively impact these fishermen in the long-term because the fisheries resources could receive benefits such as stronger stocks, more fish, and healthier habitat.

Under **Alternative 4**, effects to enforcement and fishermen would be very similar to those experienced under **Preferred Alternative 3**. If **Sub-Alternatives 4a**, **4b**, and **4c** are selected, the closed seasons for Abrir La Sierra Bank, Tourmaline Bank, and Bajo de Sico would be consistent. These consistent regulations would likely benefit enforcement agents, as it would likely be easier to enforce consistent regulations in all areas. In addition, the compatibility of regulations could benefit fishermen as it could help contribute to an ease in understanding when and where fishing is allowed. However, if only one or two sub-alternatives are selected then these positive effects would likely not occur because regulations would remain inconsistent.

Under **Sub-Alternatives 4a** and **4c** the closed seasons for Abrir La Sierra Bank and Tourmaline Bank would be lengthened by three months respectively. This increase in the length of the closed season would likely be negative for fishermen who depend on fishing for Council-managed species in Abrir La Sierra Bank and Tourmaline Bank. Under **Sub-Alternatives 4a** and **4c**, the negative impacts to fishermen and fishing communities would be similar to those detailed under **Preferred Sub-Alternatives 3a** and **3b**. However, under **Sub-Alternatives 4a** and **4c**, the open season for fishing would include the traditionally poor weather months of September and October. It is, thus, likely that safety at sea may worsen for fishermen under **Sub-Alternatives 4a** and **4c** because they may attempt to compensate for the shorter fishing season (in Abrir La Sierra Bank and Tourmaline Bank) by fishing in unsafe weather conditions during these months. Also, under **Sub-Alternatives 4a** and **4c**, the positive long-term impacts to fishermen would be similar to those detailed under **Preferred Sub-Alternatives 3a** and **3b** because the fisheries resources could receive benefits such as stronger stocks, more fish, and healthier habitat.

Under **Sub-Alternative 4b**, Bajo de Sico would remain closed for six months; however the months would be modified to December 1 through May 31. The negative impacts to fishermen and fishing communities under **Sub-Alternative 4b** would be very similar to those which currently exist under **Alternative 1 (No**

Action); however safety at sea may worsen for fishermen under **Sub-Alternative 4b** because they would likely try to fish during the traditionally poor weather months of September and October. The reef fish resources in Bajo de Sico would continue to receive six months of protection under **Sub-Alternative 4b** and the positive long-term benefits to fishermen would provide the same protections as under **Alternative 1 (No Action)** such as stronger stocks, more fish, and healthier habitat.

Alternative 5 would include the most negative impacts to fishermen and fishing communities as it would lengthen the seasonal closures of Abrir La Sierra Bank, Bajo de Sico and Tourmaline Bank to year-round under **Alternative 5a**, **5b**, and **5c** respectively. The negative impacts to fishermen and fishing communities would be similar to those detailed under **Preferred Sub-Alternatives 3a** and **3b** and **Sub-Alternatives 4a** and **4c** for Abrir La Sierra Bank and Tourmaline Bank and existing conditions under **Alternative 1 (No Action)** for Bajo de Sico; however they are expected to be more severe because the closure would be lengthened to a whole year, rather than six months. **Alternative 5** would also likely include the most positive long-term impacts to the fish stocks and habitat which could positively impact fishermen in the long-term.

If **Sub-Alternatives 5a**, **5b**, and **5c** are selected, the closed seasons for Abrir La Sierra Bank, Tourmaline Bank, and Bajo de Sico would be consistent. These consistent regulations would likely benefit enforcement agents, as it would likely be easier to enforce consistent regulations in all areas. However, if only one or two sub-alternatives are selected then these positive effects would likely not occur because regulations would remain inconsistent.

4.1.5 Direct and Indirect Effects on the Administrative Environment

Alternative 1 is the no action alternative and would not change the lengths of the three closed seasons. Fishing would still be prohibited in Abrir La Sierra Bank and Tourmaline Bank from December 1 through the last day of February and from October 1 through March 31 in Bajo de Sico. The administrative effects of **Alternative 1** are expected to be negative because this alternative would not achieve consistency between the areas. Therefore, choosing this alternative would continue current enforcement issues with respect to differences in the regulations among areas and the confusion experienced by fishers and enforcement agents regarding those regulations.

Alternative 2 proposes to prohibit fishing activities specified in Actions 2, 3, 5, and 6 as well as anchoring in Action 4 in Bajo de Sico from December 1 through the last day of February. This alternative would be expected to benefit the administrative environment the most because it would result in consistent regulations among the federal portions of the Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. This alternative would eliminate any confusion among fishers and enforcement agents about when and where fishing and anchoring is prohibited.

Preferred Alternative 3, Alternative 4, and **Alternative 5** would have in common their direct and indirect effects on the administrative environment. Each of the alternatives gives the Council the option to create consistent regulations among the three areas, thus alleviating some enforcement confusion and benefiting the administrative environment.

Under **Preferred Alternative 3, Alternative 4,** or **Alternative 5**, the Council has the option to select the alternative for one, two, or all three of the managed areas. Selecting **Sub-Alternatives a** and **b** under **Preferred Alternative 3** or **Sub-Alternatives a**, **b**, and **c** from within either **Alternative 4** or **Alternative 5** would result in consistent regulations among the three managed areas in federal waters. However, if the Council chooses a sub-alternative for one area and not the others, inconsistencies among the three areas would remain. For instance, if the Council selects **Sub-Alternative 4a**, **4b,** and **Sub-Alternative 5c**, Bajo de Sico and Abrir La Sierra Bank would have consistent regulations while Tourmaline Bank would remain inconsistent. This would hinder enforcement and perpetuate confusion among constituents.

In summary, modifying the length of the closed seasons as proposed in **Alternatives 2-5** of Action 1 would add a short-term administrative burden to promulgate the required regulations. **Alternatives 2-5** would also result in additional short-term administrative burdens for law enforcement officers to incorporate the new changes into the regulations (e.g. training agents). However, consistent regulations would result in a number of positive long-term benefits by alleviating confusion among enforcement officers and user-groups. Although developing regulations to achieve consistency and compatibility presents an administrative burden, the net administrative effects of establishing consistent fishing regulations in federal waters are expected to be positive. Enforcement would be facilitated due to consistent regulations, which allows for straightforward application of the law and removes confusion as an excuse for non-compliance. This would likely translate into fewer false or unsupportable citations, more effective identification and prosecution of actual violations, less wasted time in the legal system, and better understanding and compliance by the fishers.

4.2 Action 2: Modify Reef Fish Fishing Activities

4.2.1 Direct and Indirect Effects on the Physical Environment

Alternative 1 is the no action alternative and would not affect reef fish fishing and possession regulations within Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. As a result, no direct or indirect effects on the physical environment of the managed areas are anticipated. Management actions that affect the physical environment mostly relate to the interactions of fishing gear with the benthic habitat. Under both the current regulations (**Alternative 1**) and proposed modifications to the reef fish fishing regulations (**Alternative 2** and **Preferred Alternative 3**), the potential to damage the coral reef populations from fishing activities within the areas would remain the same. Important coral habitats found in Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank, including newly discovered mesophotic reefs, would be in danger of gear interactions, such as entanglements with fishing line.

It must be noted that Action 1 determines the direct and indirect impacts of each subsequent action (Actions 2-6). For instance, the length of the seasonal fishing closure will influence the impact of reef fish fishing activities within Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. If the Council chooses a year-round closure for all three areas, the physical environments would see the greatest direct and indirect impacts due to less gear entanglements or other interactions.

4.2.2 Direct and Indirect Effects on the Biological/Ecological Environment

Fish species that form spawning aggregations are at greater risk of overexploitation due to their reproductive strategy, which includes long distance migrations, aggregating at high densities for prolonged periods, and predictability of aggregations in space and time. Aggregations have historically been viewed as opportunities for efficiently catching large numbers of fish rather than as important components of the species' life history that must be carefully and conservatively managed. Moreover, technological advances make aggregations increasingly easy to locate and target. Demand for reef fish is growing due to market forces and growing exports (Sadovy et al. 2008).

Overfishing of spawning aggregations has been suggested to result in a number of detrimental impacts to reef fish species, including: reduced age at sexual maturity; a decrease in stock size, mean length, and recruitment; diminished density and biomass; and changes in sex-ratio (increased ratios of females to males within an aggregation). One immediate consequence of a shift in sex ratio is to lower effective population size, with cascading effects on genetic factors such as inbreeding, genotypic diversity, and population structuring (Ward et al. 2002). Sex ratio effects are also relevant to sex-changing species. In certain protogynous groupers that form spawning aggregations (such as red hind), sex ratios during

aggregation periods may be an important cue for sex change, since this is the only time when adult males and females are known to come together in significant numbers (Sadovy de Mitcheson and Erisman 2012). One of the major goals in using closed areas to manage coral reef fisheries is the protection of a critical spawning-stock population to ensure recruitment supply to fished areas via larval dispersal. Another objective is the potential maintenance or enhancement of yields in areas adjacent to reserves by adult movements (Russ and Alcala 1996).

Reductions in aggregation numbers could affect social cues that stimulate changes in reproductive condition. In some groupers, courtship activity and color pattern changes associated with spawning are less intense at sites with smaller, dispersed aggregations when compared to sites with large, dense aggregations (Sadovy de Mitcheson and Erisman 2012). Several groupers also form dominance hierarchies with males defending breeding territories. Removal of fish during aggregation spawning could affect these hierarchies, with unknown impacts on reproductive output. Since ovulation periods of aggregating species are often highly synchronized to coincide with short courtship and reproductive periods, delayed or disrupted courtship could potentially cause eggs to over-ripen, thereby reducing egg viability or developmental success of eggs and larvae (Sadovy de Mitcheson and Erisman 2012).

Unregulated fishing of spawning aggregations is thought to have led to local extinctions and even the collapse of some fisheries, including for example Nassau grouper. Nassau grouper was once the most valuable grouper species in the Caribbean fishery. The species may travel more than 100 km from its resident reef to an aggregation site, where all reproduction occurs over just a few days during a few months each year (Sadovy et al. 2008). However, it is estimated that approximately 35% of all known Nassau grouper spawning aggregations have been extirpated (Kobara et al. 2013). Additionally, population abundance and fishery landings of the species remain low. Nassau grouper was the first reef fish, and one of the only fully marine commercial species, to be listed as a species of concern under the U.S. Endangered Species Act (Kobara et al. 2013; Sadovy et al. 2008).

Alternative 1 is the no action alternative and would leave current regulations intact. All of Abrir La Sierra Bank and the federal portion of Tourmaline Bank would remain closed to fishing for all species, including Council-managed reef fish, spiny lobster, coastal migratory species, and HMS, during the time specified in Action 1. Under **Alternative 1**, the federal portion of Bajo de Sico would remain closed to fishing for and possession of Council-managed reef fish (no transiting through the area with reef fish onboard). **Alternative 2** would similarly prohibit fishing for Council-managed reef fish in Bajo de Sico during the seasonal closure established in Action 1, but it would allow possession of Council-managed reef fish in that area. **Preferred Alternative 3** would prohibit fishing for Council-managed reef fish in either or both of the Abrir La Sierra Bank (**Preferred Sub-Alternative 3a**) and Tourmaline Bank (**Preferred Sub-Alternative 3b**) areas during the seasonal closure, depending on the sub-alternative(s) chosen. Similar to **Alternative 1**, fishers would not be allowed to transit the area(s) with Council-managed reef fish onboard. **Preferred Alternative 3** would also remove the fishing prohibition on

coastal migratory pelagic and other species not managed by the Council, thus resulting in direct negative impacts to those populations.

Due to the similarities between **Alternative 1, Alternative 2,** and **Preferred Alternative 3**, they are expected to result in the same direct impacts to the reef fish biological and ecological environments of the three managed areas. Fishing prohibitions would have both short-term and long-term benefits to the reef fish species found within the areas. More immediate impacts would include reduced directed pressure and fishing mortality. In the long term, the populations would achieve a more natural sex ratio, age, and size structure. The possession provision in **Alternative 1** and **Preferred Alternative 3** is for enforcement purposes and would not have any direct impacts to the spawning aggregations within Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. It could, however, result in indirect benefits to the species outside the areas because fishers may avoid the entire area altogether if they cannot transit through Abrir La Sierra Bank, Bajo de Sico, or Tourmaline Bank. According to interviews conducted by Tonioli and Agar (2009), while current fishing regulations do not prevent fishermen from transiting through Abrir La Sierra Bank and Tourmaline Bank, most fishers steer clear from the two areas when fish are on board to avoid being stopped and possibly cited by the U.S. Coast Guard.

The biological effects of **Alternative 1, Alternative 2,** and **Preferred Alternative 3** on ESA-listed species are anticipated to be very similar to those described in Action 1.

4.2.3 Direct and Indirect Effects on the Economic Environment

Action 2 concerns modification of regulations regarding possession of Council-managed reef fish during seasonal closures. **Alternative 1** retains existing reef fish harvest regulations, which include closures to all fishing activities during closure periods except Bajo de Sico, which allows for harvest of spiny lobster, HMS, and coastal migratory pelagics. **Alternative 2** prohibits fishing for Council-managed reef fish in Bajo de Sico during the seasonal closure under Action 1, which is already implemented under **Alternative 1** but allows for possession of reef fish. **Preferred Alternative 3** is more restrictive than **Alternatives 1** and **2** in that it restricts fishing for or possession of Council-managed reef fish.

In general, the less restrictive the regulations regarding possession, the more flexibility fishermen have in moving from one fishing area to another because they can transport fish caught in one area to another area where fishing will take place. However, this also makes enforcement more difficult, which could undermine protection of the managed areas.

Under **Alternative 1 (No Action)**, there would be no change in fishery regulations and therefore no expected changes in economic benefits. Under **Alternative 1 (No Action)**, Abrir La Sierra Bank and Tourmaline Bank would remain closed to all fishing activities. Bajo de Sico would remain closed to

fishing for Council-managed reef fish. A ban on bottom-tending gear (pots, traps, bottom longlines, gillnets, trammel nets) would continue. A restriction on transit with possession of Council-managed reef fish would continue in Bajo de Sico. There are long-term economic benefits to the existence of the current regulations in that they protect the benthic habitat and make enforcement easier. Both of these result in healthier stocks and potentially higher future landings and revenues for commercial and recreational fishermen.

Alternative 2 would allow fishers to travel through Bajo de Sico with Council-managed reef fish harvested at other locations. This allows for greater fisher flexibility but decreases enforcement capability.

Under **Preferred Alternative 3**, transiting would not be allowed with Council-managed reef fish and this decreases fishing flexibility. If both sub-alternatives under **Preferred Alternative 3** are chosen, there would be consistency among all three managed areas in federal regulations. Under this assumption, **Preferred Alternative 3** would have less economic benefits than **Alternative 2**.

4.2.4 Direct and Indirect Effects on the Social Environment

This action would directly impact commercial, recreational, and subsistence fishermen who fish for Council-managed reef fish species in or around Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. Enforcement agents responsible for enforcing regulations in these areas would also be directly impacted. In addition, fishermen who don't fish in these seasonally closed areas, but depend on species which occur in these areas, could be indirectly impacted by this action.

Under **Alternative 1 (No Action)**, Abrir La Sierra Bank and Tourmaline Bank would continue to be closed to fishing for all species, including Council-managed reef fish, spiny lobster, coastal migratory pelagics, and HMS. And Bajo de Sico would remain closed to fishing for or possession of Council-managed reef fish species under **Alternative 1 (No Action)**. Protections provided under **Alternative 1 (No Action)** would remain in place with long-term benefits for fishermen and fishing communities resulting from the prohibition of Council-managed reef fish fishing in Bajo de Sico and fishing for all fish in Abrir La Sierra Bank and Tourmaline Bank. Resulting benefits to fishermen can include stronger stocks, more fish, and healthier habitat.

Alternative 2 would prohibit fishing for Council-managed reef fish in Bajo de Sico during the seasonal closure established in Action 1, but would allow fishermen to possess reef fish caught in another area. Under **Alternative 2**, fishermen would be allowed to transit through Bajo de Sico with reef fish caught in another area. This is likely to positively benefit reef fish fishermen as they would not have to avoid Bajo de Sico during the closed season if they possessed Council-managed reef fish on their vessel. However, it is likely that allowing the possession of Council-managed reef fish under **Alternative 2** could make it

more difficult for enforcement agents, as it is difficult to discern the catch area unless the catch area is witnessed by enforcement. When fishermen are encountered by enforcement they could claim that their catch was harvested in other waters, even if it was harvested in Bajo de Sico. The difficulty in discerning catch area by enforcement could result in a lower amount of protection for reef fish in Bajo de Sico.

However, under **Alternative 2**, Bajo de Sico, Tourmaline Bank, and Abrir La Sierra Bank would include consistent regulations for the transiting of reef fish. Conversely, this could contribute to an ease in enforcement by enforcement agents. The consistent regulations under **Alternative 2** could also contribute to an ease in understanding and following regulations by fishermen.

Preferred Alternative 3 would prohibit fishing for and possession of Council-managed reef fish during the seasonal closure established in Action 1 for Abrir La Sierra Bank (**Preferred Sub-Alternative 3a**) and Tourmaline Bank (**Preferred Sub-Alternative 3b)**. If both **Preferred Sub-Alternative 3a** and **Preferred Sub-Alternative 3b** are selected, regulations would be consistent for Abrir La Sierra Bank, Tourmaline Bank, and Bajo de Sico with the possession of Council-managed reef fish prohibited in each area. Consistent regulations could result in a reduction in enforcement by enforcement agents. The consistent regulations under **Preferred Sub-Alternative 3a** and **Preferred Sub-Alternative 3b** could also contribute to an ease in understanding and following regulations by fishermen. However, if only one sub-alternative is selected then these positive effects would likely not occur because regulations would remain inconsistent. In addition, **Preferred Sub-Alternative 3a** and **Preferred Sub-Alternative 3b** could result in further protections to the reef fish resource because fishermen would not be allowed to possess Council-managed reef fish in Abrir La Sierra Bank and Tourmaline Bank. It would likely be less possible to illegally harvest reef fish in these areas. These protections could result in benefits to fishermen in the long-term including more fish and healthier stocks.

Under **Preferred Sub-Alternative 3a** and **Preferred Sub-Alternative 3b** fishermen would avoid the areas of Abrir La Sierra Bank and Tourmaline Bank if they possessed Council-managed reef fish which could result in negative effects, however small, to fishermen.

4.2.5 Direct and Indirect Effects on the Administrative Environment

Alternative 1 is the no action alternative and would not change the reef fish regulations within the three managed areas. All fishing would still be prohibited in Abrir La Sierra Bank and Tourmaline Bank, although possession would be allowed. Fishing for and possession of Council-managed reef fish would still be prohibited in Bajo de Sico. The administrative effects of **Alternative 1** are expected to be negative because this alternative would not achieve consistency between the areas. Therefore, choosing this alternative would continue current enforcement issues, such as the differences in the regulations among areas and the confusion experienced by fishers and enforcement agents regarding in which areas Council-managed reef fish fishing and/or possession is allowed.

Alternative 2 proposes to continue the prohibition on fishing for Council-managed reef fish in Bajo de Sico, for the duration of the seasonal closure established in Action 1, but would allow possession. This alternative would be expected to benefit the administrative environment the most because it would result in consistent regulations among the federal portions of the Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. This alternative would eliminate any confusion among fishers and enforcement agents about when and where Council-managed reef fish fishing is prohibited.

Preferred Alternative 3 would prohibit fishing for and possession of Council-managed reef fish during the seasonal closure. This alternative gives the Council the option to create consistent regulations among the three areas, thus alleviating some enforcement confusion and benefiting the administrative environment.

The Council has the option to select **Preferred Alternative 3** for Abrir La Sierra Bank (**Preferred Sub-Alternative 3a**), Tourmaline Bank (**Preferred Sub-Alternative 3b**), or both areas. If the Council chooses **Preferred Alternative 3** for both areas, there would be consistent reef fish regulations between all three managed areas (Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank). However, if the Council selects only **Preferred Sub-Alternative 3a**, Bajo de Sico and Abrir La Sierra Bank would have consistent regulations but Tourmaline Bank reef fish fishing regulations would not be consistent with the other two areas. This would not facilitate enforcement or avoid confusion among constituents.

In summary, modifying the reef fish regulations as proposed in **Alternatives 2-3** of Action 2 would add a short-term administrative burden to promulgate the required regulations. **Alternatives 2-3** would also result in additional short-term administrative burdens for law enforcement officers to incorporate the new changes into the regulations (e.g. training agents). However, consistent regulations would result in a number of positive long-term benefits by facilitating enforcement, alleviating confusion, and potentially increasing compliance. Although developing regulations to achieve consistency presents an initial administrative burden, the net administrative effects of establishing consistent regulations in federal waters are expected to be positive because consistency allows for straightforward application of the law and removes confusion as an excuse for non-compliance. This would likely translate into fewer false or unsupportable citations, more effective identification and prosecution of actual violations, less wasted time in the legal system, and better understanding and compliance by the fishers.

4.3 Action 3: Modify Spiny Lobster Fishing Activities

4.3.1 Direct and Indirect Effects on the Physical Environment

Action 3 proposes to modify the spiny lobster regulations within the managed areas. Spiny lobster are normally harvested by hand and in traps. However, current regulations prohibit the use of bottom-tending gear, including traps, inside Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. Therefore, any harvest of spiny lobster from the three areas would have to be done by hand harvest. Hand harvesting methods are expected to have little to no adverse impacts on the physical environment. **Alternative 1** is the no action alternative and would not result in any changes to the spiny lobster regulations within the managed areas. Fishing for lobster is presently allowed in Bajo de Sico but not in Abrir La Sierra Bank and Tourmaline Bank. Therefore, continuing to allow spiny lobster fishing in Bajo de Sico will have no additional direct or indirect effects on the physical environment of Bajo de Sico. Conversely, the physical environments in Abrir La Sierra Bank and Tourmaline Bank may be subject to direct and indirect impacts by gear interactions, such as anchors. However, Action 4 proposes to prohibit anchoring so impacts to the physical environments would be contingent upon the results of Action 4. If anchoring is prohibited in Abrir La Sierra Bank and Tourmaline Bank, the physical environments would suffer no direct or indirect impacts caused by anchors.

Alternative 2 would prohibit fishing for spiny lobster in Bajo de Sico for the duration of the seasonal closure established in Action 1, thereby establishing spiny lobster regulations consistent with Abrir La Sierra Bank and Tourmaline Bank. Similarly, **Alternative 3** would prohibit fishing for lobster but would also prohibit the possession of lobster in Abrir La Sierra Bank (**Sub-Alternative 3a**), Bajo de Sico (**Sub-Alternative 3b**), and Tourmaline Bank (**Sub-Alternative 3c**). Under these alternatives, fishing for spiny lobster would still remain open part of the year unless a year-round closure is established for each area (Action 1, Alternative 5). During the open season, vessels could still be present in the areas, potentially resulting in direct negative impacts to the physical environments through interactions between habitat and gear (e.g. anchors).

Alternative 4 would establish a year-round prohibition of fishing for spiny lobster in Abrir La Sierra Bank (**Sub-Alternative 4a**), Bajo de Sico (**Sub-Alternative 4b**), and Tourmaline Bank (**Sub-Alternative 4c**). Similar to **Alternative 3**, **Alternative 5** would prohibit fishing for and possession of spiny lobster in Abrir La Sierra Bank (**Sub-Alternative 5a**), Bajo de Sico (**Sub-Alternative 5b**), and Tourmaline Bank (**Sub-Alternative 5c**) throughout the year. In contrast to **Alternatives 2** and **3**, each of the Sub-Alternatives under **Alternatives 4** and **5** would provide the greatest benefits to the physical environment because either of these alternatives provides a year-round prohibition on fishing for lobster as well as protection to habitats from interactions with divers and anchors.

Preferred Alternative 6 would allow fishing for spiny lobster year-round throughout the federal portions of the three managed areas. As previously discussed, hand harvest is the only allowable harvest methods within Abrir La Sierra Bank (**Preferred Sub-Alternative 6a**), Bajo de Sico (**Preferred Sub-Alternative 6b**), and Tourmaline Bank (**Preferred Sub-Alternative 6c**). As such, allowing harvest of spiny lobster will not result in direct or indirect impacts to the physical environment. The only possible threat would be interactions with anchors. However, Action 4 proposes to prohibit anchoring year-round, which would protect the benthic habitat from direct impacts of anchor interactions.

4.3.2 Direct and Indirect Effects on the Biological/Ecological Environment

Alternative 1 is the no action alternative and would not change the spiny lobster regulations within the three managed areas. Fishing for of spiny lobster would still be prohibited in Abrir La Sierra Bank and Tourmaline Bank but allowed in Bajo de Sico. As a result, there would be no additional direct or indirect impacts to the biological or ecological environments. The spiny lobster populations in Abrir La Sierra Bank and Tourmaline Bank would still be protected from direct fishing pressure while the population in Bajo de Sico would continue to be vulnerable to fishing mortality.

Currently, the Bajo de Sico lobster population could be experiencing an increase in fishing mortality as fishers shift effort from Tourmaline Bank and Abrir La Sierra Bank. However, under current regulations, there are no methods for fishery managers to prevent that from occurring. **Alternative 2** would provide managers that authority by prohibiting fishing for spiny lobster within Bajo de Sico for the duration of the seasonal closure established in Action 1. This alternative would provide a direct benefit to the Bajo de Sico spiny lobster population by preventing effort shifting from Abrir La Sierra Bank and Tourmaline Bank and a resultant increase in fishing pressure on the Bajo de Sico population during the seasonal closure. However, unless the closure for all three areas is year-round, spiny lobsters are not provided any protection outside of the seasonal closure and are vulnerable to fishing pressure.

Alternative 3 would prohibit fishing for and possession of spiny lobster in Abrir La Sierra Bank (**Sub-Alternative 3a**), Bajo de Sico (**Sub-Alternative 3b**), and Tourmaline Bank (**Sub-Alternative 3c**) during the established seasonal closure. Similar to **Alternative 2**, **Alternative 3** would provide short-term protection to spiny lobster populations. However, since **Alternative 3** designates the seasonal closure established in Action 1 (provided the Council does not choose Alternative 5 in Action 1), populations within the managed areas still face long-term vulnerabilities. Fishers can target spiny lobsters outside the seasonal closure. Spiny lobster harvest is constrained by recreational bag limits and ACLs so the overall Caribbean population would not face the threat of overfishing, however, strong harvest in one or two small areas (such as Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank) may result in local impacts with respect to density-dependent activities such as reproduction.

Alternative 4 would prohibit fishing for spiny lobster all year, and **Alternative 5** would prohibit fishing for and possession all year, in Abrir La Sierra Bank (Sub-Alternative a), Bajo de Sico (Sub-Alternative b), and Tourmaline Bank (Sub-Alternative c). Each sub-alternative would provide the same protections and benefits (both short-term and long-term) to lobster populations. A year-round spiny lobster fishing prohibition would provide the greatest benefits to the biological and ecological environments because lobsters would be protected from directed fishing pressure and mortality all year. **Alternative 5** provides the added benefit of facilitated enforcement because there would be no issue regarding where the lobster may have been harvested.

Alternatives 4 and **5** become especially important if the Council chooses to not implement a year-round general fishing closure for the three managed areas but still wants to implement a year-round closure specifically for spiny lobster. This would allow fishers to fish for Council-managed reef fish, HMS, or coastal migratory pelagics and other non-managed species during the specified closed season but would still provide direct benefits to the spiny lobster population.

Preferred Alternative 6 would allow fishing for spiny lobster year-round in Abrir La Sierra Bank (**Preferred Sub-Alternative 6a**), Bajo de Sico (**Preferred Sub-Alternative 6b**), and Tourmaline Bank (**Preferred Sub-Alternative 6c**). Allowing fishing for spiny lobster year-round would provide the least amount of protection to the lobster populations within the three managed areas. However, spiny lobster harvest in the U.S. Caribbean is constrained by an ACL to prevent the species from undergoing overfishing and fishers would be required to remain below that threshold. Therefore, allowing spiny lobster harvest in the three managed areas would not have any significant direct or indirect impacts to the lobster population.

Alternative 1 would perpetuate the existing level of risk for interactions between ESA-listed species and fishermen and would likely be slightly more biologically beneficial than **Alternative 6**. **Alternative 6** is the least biologically beneficial to ESA-listed species. Removing the existing prohibitions on spiny lobster harvest will increase the potential for interactions between fishermen/gear and ESA-listed species. **Alternatives 4** and **5** would be the most biologically beneficial to ESA-listed species and would likely have very similar, if not, identical effects to those species. Relative to **Alternative 2**, **Alternative 3** is likely to be slightly more biologically beneficial to ESA-listed species. The potential closure of all three areas during the seasonal closures established would likely provide more protections to ESA-listed species, particularly *Acropora*, than implementing a seasonal closure only at Bajo de Sico.

4.3.3 Direct and Indirect Effects on the Economic Environment

Action 3 alternatives propose changes to spiny lobster fishing activities in the three managed areas. **Alternative 2** proposes no fishing for spiny lobster during the closed season in Bajo de Sico. **Alternative**

3 proposes no fishing or possession in the each of the managed areas (as sub-alternatives). **Alternative 4** prohibits fishing for spiny lobster year-round in each of the areas (as sub-alternatives) while **Alternative 5** prohibits fishing and possession of spiny lobster year-round in each of the areas (as sub-alternatives).

Alternatives 2 and **4** allow for possession of spiny lobster. Possession allows for greater fishing flexibility in that more than one area can be fished in a single trip which saves fishermen the cost of additional travel (diesel, opportunity cost associated with extra time).

Alternatives 4 and **5** propose year-round closures while **Alternatives 2** and **3** propose closures that may not be year-round (depending on alternatives chosen under Action 1). Year-round closures could significantly reduce annual landings and revenues for fishermen and reduce short-term economic benefits if the closure applies to all species (**Action 1, Alternative 5**). If the year-round closure only applies to spiny lobster, then other species could be harvested for some of the year and short-term economic benefits would be higher than otherwise. The long-term economic benefits from a year-round closure of lobster fishing would be in the form of healthier lobster stocks and potentially higher future landings. A year-round closure on spiny lobster fishing combined with no possession of spiny lobster in the managed areas would have the least economic benefits.

Preferred Alternative 6 would allow fishing for spiny lobster year-round in Abrir La Sierra Bank (**Preferred Sub-Alternative 6a**), Bajo de Sico (**Preferred Sub-Alternative 6b**), and Tourmaline Bank (**Preferred Sub-Alternative 6c**). As stated above, allowing fishing for spiny lobster year-round would provide the least amount of protection to the lobster populations within the three managed areas but harvest is constrained by an ACL which prevents any significant direct or indirect impacts to the lobster population. Subsequently, **Preferred Alternative 6** would provide the greatest short-term and long-term economic benefits for fishermen.

Under **Alternative 1 (No Action)**, there would be no change in fishery regulations and therefore no expected changes in economic benefits. **Alternative 2** proposes the least restrictive regulations, after **Preferred Alternative 6**, in that it allows for transit (possession) and a seasonal closure for spiny lobster (whose length will depend on the alternatives chosen under Action 1). Only **Alternative 2** proposes consistent regulations between Federal and Commonwealth waters. For these reasons, **Alternative 2** will likely have the third greatest economic benefits after **Preferred Alternative 6** and then **Alternative 1**, which allows for spiny lobster fishing in Bajo de Sico, followed by **Alternatives 3**, **4**, and **5** in that order. **Alternative 5** would offer the least economic benefits due to a year-round spiny lobster closure and a ban on transiting.

4.3.4 Direct and Indirect Effects on the Social Environment

This action would directly impact commercial, recreational, and subsistence fishermen who fish for spiny lobster in or around Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. Enforcement agents responsible for enforcing regulations in these areas would also be directly impacted In addition, fishermen who don't fish in these seasonally closed areas, but depend on species which occur in these areas could be indirectly impacted by this action.

Under **Alternative 1 (no action)**, Abrir La Sierra Bank and Tourmaline Bank would continue to be closed to fishing for all species including reef fish, coastal pelagics, HMS, and spiny lobster. And Bajo de Sico would remain closed to fishing for or possession of Council-managed reef fish species under **Alternative 1 (no action)**; however spiny lobster fishing is allowed in federal waters in Bajo de Sico. Under **Alternative 1 (no action)**, regulations regarding fishing for and possessing spiny lobster would remain inconsistent in Abrir La Sierra Bank, Tourmaline Bank, and Bajo de Sico. This could contribute to a continued difficulty in enforcing regulations in these areas because of the varying regulations. In addition, the varying regulations regarding fishing for and possession of spiny lobster could contribute to a continued difficulty for fishermen in understanding where fishing is allowed.

Alternative 2 would prohibit fishing for spiny lobster in Bajo de Sico during the seasonal closure established in Action 1. Under **Alternative 2**, Bajo de Sico, Tourmaline Bank, and Abrir La Sierra Bank would include consistent regulations for the prohibition of fishing for spiny lobster. This could contribute to an ease in enforcement by enforcement agents. The consistent regulations under **Alternative 2** could also contribute to an ease in understanding and following regulations by fishermen. However, spiny lobster fishermen that would be negatively impacted under **Alternative 2** because they would no longer be allowed to fish for spiny lobster in the federal waters of Bajo de Sico. Conversely, the prohibition of fishing for spiny lobster in the federal waters of Bajo de Sico could positively impact spiny lobster fishermen in the long-term because the resource would likely receive benefits from a decrease in effort. Fishermen could see resulting benefits including healthier stocks and more spiny lobster, which could be caught in areas outside of Bajo de Sico.

Alternative 3 would prohibit fishing for and possession of spiny lobster in Bajo de Sico during the seasonal closure established in Action 1 in Abrir La Sierra Bank (**Sub-Alternative 3a**), Bajo de Sico (**Sub-Alternative 3b**), and Tourmaline Bank (**Sub-Alternative 3c**). If all sub-alternatives are selected, regulations would be consistent between the three seasonally closed areas with prohibition of fishing for and possession of spiny lobster during the seasonal closures in each area. This could contribute to an increase in ease of enforcement by enforcement agents and an increase in ease of understanding and following regulations by fishermen. However, if only one sub-alternative is selected then these positive effects would likely not occur because regulations would remain inconsistent.

In addition, **Sub-Alternative 3a**, **3b**, and **3c** could result in further protections to the spiny lobster resource because fishermen would not be allowed to possess spiny lobster in Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. It would likely be less possible to illegally harvest spiny lobster in these areas because fishermen would not be able to possess spiny lobster. These protections could result in benefits to fishermen in the long-term including more spiny lobster and healthier stocks. Conversely, the inability to possess spiny lobster in Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank during the closed seasons could be negative for fishermen. Under **Sub-Alternative 3a-3c**, fishermen would likely avoid these areas if they possessed spiny lobster which could result in negative effects, however small, to fishermen.

Alternative 4 would prohibit fishing spiny lobster year-round in Abrir La Sierra Bank (**Sub-Alternative 4a**), Bajo de Sico (**Sub-Alternative 4b**), and Tourmaline Bank (**Sub-Alternative 4c**). The effects under **Alternative 4** would be similar to those under **Alternative 2**; however the negative effects would be experience to a greater extent by spiny lobster fishermen because fishing would be closed year-round. If all sub-alternatives are selected, Bajo de Sico, Tourmaline Bank, and Abrir La Sierra Bank would include consistent regulations for the prohibition of fishing for spiny lobster. This could contribute to an ease in enforcement by enforcement agents. The consistent regulations under **Alternative 4** could also contribute to an ease in understanding and following regulations by fishermen. However, spiny lobster fishermen would be negatively impacted to a greater degree under **Alternative 4** because they would no longer be allowed to fish year-round for spiny lobster in the federal waters of Bajo de Sico, Tourmaline Bank, Abrir La Sierra Bank.

Alternative 5 would prohibit fishing for and possession of spiny lobster year-round in Abrir La Sierra Bank (**Sub-Alternative 5a**), Bajo de Sico (**Sub-Alternative 5b**), and Tourmaline Bank (**Sub-Alternative 5c**). The effects under **Alternative 5** would be similar to those under **Alternative 3**; however the negative effects would be experience to a greater extent by fishermen because fishing and possession of spiny lobster would be closed year-round. If all sub-alternatives are selected, regulations would be consistent between the three seasonally closed areas with prohibition of fishing for and possession of spiny lobster during the seasonal closures in each area. This could contribute to an increase in ease in enforcement by enforcement agents and an increase in ease in understanding and following regulations by fishermen. However, if only one sub-alternative is selected then these positive effects would likely not occur because regulations would remain inconsistent. Fishermen would likely avoid these areas if they possessed spiny lobster which could result in negative effects, however small, to fishermen. Spiny lobster fishermen would be negatively impacted to a greater degree under **Alternative 5** because they would no longer be allowed to fish or possess spiny lobster year-round in the federal waters of Bajo de Sico, Tourmaline Bank, Abrir La Sierra Bank.

Preferred Alternative 6 would allow fishing for spiny lobster year-round in the federal portions of Abrir La Sierra Bank (**Preferred Sub-Alternative 6a**), Bajo de Sico (**Preferred Sub-Alternative 6b**), and Tourmaline Bank (**Preferred Sub-Alternative 6c**). Spiny lobster fishermen are expected to be

positivitely impacted to the greatest degree under **Preferred Sub-Alternatives 6a-c** because they would be allowed to fish year-round for spiny lobster in the federal waters of the three areas (although currently fishermen are allowed to fish for spiny lobster year-round in the federal portion of Bajo de Sico; therefore the current regultions for spiny lobster in Bajo de Sico would be continued under **Preferred Sub-Alternative 6b**). Conversely, allowing spiny lobster fishing year-round in these areas could be negative for the spiny lobster resource as the resource would not receive the current level of protection provided in Abrir La Sierra Bank and Tourmaline Bank during the seasonal closure, although the ACL would still be in place for spiny lobster. Allowing spiny lobster fishing year-round could indirectly impact fishermen in a negative manner as they would not experience possible benefits from a seasonal closure such as healthier stocks and more spiny lobster. If all sub-alternatives are selected, regulations would be consistent between the three areas with fishing allowed for spiny lobster year-round in each area. This could contribute to an increase in ease of enforcement by enforcement agents and an increase in ease of understanding and following regulations by fishermen. However, if only one sub-alternative is selected then these positive effects would likely not occur because regulations would remain inconsistent.

4.3.5 Direct and Indirect Effects on the Administrative Environment

Alternative 1 is the no action alternative and would not change the spiny lobster regulations within the three managed areas. Fishing for spiny lobster would still be prohibited in Abrir La Sierra Bank and Tourmaline Bank but allowed in Bajo de Sico. The administrative effects of **Alternative 1** are expected to be negative because it would not achieve consistency among the areas and therefore would continue current enforcement issues. As discussed in Section 2.3, current enforcement issues have to do with differences in the regulations between the areas and the confusion to both enforcement agents and fishers about which areas and when spiny lobster harvest is allowed.

Alternative 2 proposes to prohibit fishing for spiny lobster in Bajo de Sico for the duration of the seasonal closure established in Action 1. This alternative would be expected to benefit the administrative environment the most because it would result in consistent regulations among the federal portions of the Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. This alternative would eliminate any confusion among fishers and enforcement agents about when and where spiny lobster harvest is allowed.

Under **Alternatives 3-6**, the Council has the option to select the alternative for one, two, or all three of the managed areas. Selecting **Sub-Alternatives a**, **b**, and **c** would result in consistent regulations among the three areas in federal waters. However, if the Council chooses an alternative for one area and not the others, inconsistencies between the three areas would remain. For instance, if the Council selects **Sub-Alternative 4a**, **4b,** and **Sub-Alternative 3c**, Bajo de Sico and Abrir La Sierra Bank would have consistent regulations while Tourmaline Bank regulations would be inconsistent with those two. This would not facilitate enforcement or avoid confusion among constituents.

Alternatives 3-6 would have the equivalent direct and indirect effects on the administrative environment. Each of the alternatives gives the Council the option to create consistent regulations among the three areas, thus alleviating some enforcement confusion and benefiting the administrative environment.

Alternatives 2 and **4** would allow possession of spiny lobster, while **Alternatives 3** and **5** would prohibit the possession of spiny lobster, for the specified durations. A prohibition on possession would alleviate some enforcement concerns because agents would be better able to ensure compliance. If possession is prohibited, it would be clear whether fishers are in violation. If possession is allowed, agents have no way of determining if the possessed spiny lobster were harvested in the closed area or elsewhere.

Preferred Alternative 6 would allow fishers to fish for spiny lobster all year. If each of the sub-alternatives are chosen, this alternative would provide the least confusion among constituents because spiny lobster harvest and possession would be allowed throughout the region. Neither enforcement agents nor fishers would be confused as to where and when fishing for spiny lobster is allowed.

In summary, modifying the spiny lobster regulations as proposed in **Alternatives 2-6** of Action 3 would add a short-term administrative burden to promulgate the required regulations. **Alternatives 2-6** would also result in additional short-term administrative burdens for law enforcement officers to implement the regulatory changes (e.g. training agents). However, consistent regulations would result in a number of positive long-term benefits by alleviating confusion among enforcement officers and user groups. Although developing regulations to achieve consistency and compatibility presents an administrative burden, the net administrative effects of establishing consistent harvest regulations in federal waters are expected to be positive. Enforcement would be facilitated due to consistent regulations, which allows for straightforward application of the law and removes confusion as an excuse for non-compliance. This would likely translate into fewer false or unsupportable citations, more effective identification and prosecution of actual violations, less wasted time in the legal system, and better understanding and compliance by the fishers.

4.4 Action 4: Prohibit Anchoring

4.4.1 Direct and Indirect Effects on the Physical Environment

Corals and the structure they create are an essential component of coral reef ecology. Anchoring causes substantial and long lasting damage to coral populations (Tratalos and Austin, 2001). Not only is setting anchors harmful to coral populations, but retrieval of the anchors and the movement of the anchor or anchor chain while on the ocean floor also causes damagel (Dinsdale and Harriott, 2004). Each time a vessel drops their anchor onto a coral reef, or an anchor strikes against corals, there is a risk of coral fracture, abrasion to surface tissue and carbonate skeletons, removal of colonies from the substratum, or even death of the coral colony (Dinsdale and Harriott, 2004).

Anchoring can also indirectly impact the long-term growth of coral populations. As corals are damaged, they must divert energy from growth to repair (Dinsdale and Harriott, 2004). As coral populations decline, fish populations area impacted by loss of essential habitat. Data indicate that reefs damaged by anchoring activities may take more than 50 years to recover, if they are ever able to do so (Allen, 1992).

Alternative 1 is the no action alternative and would not result in any change to the anchoring provisions within the three managed areas. Therefore, **Alternative 1** would have no additional direct or indirect effect on the physical environment of Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. Bajo de Sico would continue to be protected from interactions between habitat and anchors while Abrir La Sierra Bank and Tourmaline Bank would continue to be vulnerable to such interactions. Maintaining the current regulations in Abrir La Sierra Bank and Tourmaline Bank would not benefit the physical environments and may, in fact, lead to declines if important reef processes are interrupted due to interactions with anchors. The coral reef's ability to survive and replenish degraded habitat may be compromised by interruptions in these processes.

Alternative 2 would prohibit anchoring within the managed areas during the seasonal closure established in Action 1. This alternative would increase protection to the physical environment in Abrir La Sierra Bank (**Sub-Alternative 2a**) and Tourmaline Bank (**Sub-Alternative 2c)** but would reduce such protection in Bajo de Sico (**Sub-Alternative 2b)** unless a year-round closure is established for Bajo de Sico in Action 1. Currently, Bajo de Sico is closed to anchoring throughout the year. Opening Bajo de Sico to anchoring for part of the year would result in increased interactions between anchors and benthic habitat and possibly increase degradation of these important habitats.

While **Alternative 2** would provide some protection for part of the year, the damage inflicted upon the coral habitats when anchoring is allowed would remain during the period when anchoring is prohibited. Anchoring has a high probability of damaging vulnerable and slow-growing coral reef populations. Even slight damage can require years of recovery.

Preferred Alternative 3 would provide the greatest benefit to the physical environment because it would prohibit fishing vessels from anchoring in Abrir La Sierra Bank (**Preferred Sub-Alternative 3a**) and Tourmaline Bank (**Preferred Sub-Alternative 3b**) throughout the year, consistent with the present situation in Bajo de Sico. A year-round anchoring prohibition greatly reduces the likelihood of damaging interactions between benthic habitat and anchors, minimizing physical impacts and resultant degradation of coral reef resources.

4.4.2 Direct and Indirect Effects on the Biological/Ecological Environment

Alternative 1 would not result and any direct or indirect effects on the biological or ecological environments. Under current regulations, anchoring is allowed in Abrir La Sierra Bank and Tourmaline Bank, thus affording the possibility of coral damage. Without healthy coral populations, reef ecosystems may begin to decline, affecting important habitat areas, which ultimately impacts the biological and ecological environment by reducing biodiversity and further limiting habitat. However, anchoring would still be prohibited in Bajo de Sico throughout the year, resulting in continued direct protection of the habitat and the indirect protection of the biological/ecological environments.

Relative to **Alternative 1**, **Alternative 2** enhances the protection of benthic habitats, including coral reef resources, in Abrir La Sierra Bank and Tourmaline Bank for the closure period chosen in Action 1, but less protection in Bajo de Sico unless **Alternative 5** of Action 1 is chosen. As discussed above, allowing anchoring for even a part of the year could still result in permanent damage to the coral habitat. Any damage to the benthic habitat could cause ecological damage, causing hardship to the marine species within the managed areas (e.g. degradation to residential habitat and reduced foraging opportunity).

Regardless of the closure period chosen in Action 1, **Preferred Alternative 3** provides the most direct protection to the physical environments of Abrir La Sierra Bank (**Preferred Sub-Alternative 3a**) and/or Tourmaline Bank (**Preferred Sub-Alternative 3b**), therefore, the most indirect benefits to the ecological and biological environments. Healthier habitats provide better ecological services to local populations, such as abundant prey and better shelter opportunities.

The impacts of anchoring to sea turtles are expected to be minimal regardless of the alternative selected; however, *Acropora* can be damaged by anchors. **Alternative 1** would perpetuate the existing level of risk for *Acropora* injuries resulting from anchoring, and would likely be the least biologically beneficial alternative for these species. **Alternative 2** would be more biologically beneficial to *Acropora* than **Alternative 1,** yet only closing these areas for a part of the year still leaves them vulnerable to anchoring damage during the parts of the year when anchoring is allowed. **Preferred Alternative 3** is the most biologically beneficial alternative for *Acropora*. The potential closure of all three areas year-round would likely eliminate any potential anchoring damage to *Acropora*.

4.4.3 Direct and Indirect Effects on the Economic Environment

Alternatives under **Action 4** result in anchoring bans for different lengths of time. Any anchoring ban is expected to have long-run economic benefits compared to no anchoring ban. An increase in the length of the anchoring ban increases long-run economic benefits. An anchoring ban increases economic benefits because it decreases harmful effects to coral communities and other fish habitat. Increases in health and growth of coral communities that increase fish habitat are expected to improve long-run stock health, subsequent catches and profits.

Under **Alternative 1 (No Action)**, anchoring regulations would remain as they are now. Currently, anchoring is not allowed in Bajo de Sico but there are no restrictions in Abrir La Sierra Bank or Tourmaline Bank. The continuation of anchoring in Abrir La Sierra Bank and Tourmaline Bank is resulting in long-term adverse economic effects from possible damage to fish habitat and fish stocks. In addition, the **Alternative 1 (No Action)** continues the situation of incompatible regulations with Puerto Rico, which risks the health of the resource and could result in greater long-term adverse economic effects.

Alternative 2 proposes a ban on anchoring during a fishing closure. **Sub-alternative 2a** proposes a ban on anchoring in Abrir La Sierra Bank while **Sub-alternatives 2b** and 2**c** stipulate bans on anchoring in Bajo de Sico and Tourmaline Bank. The greatest long-term economic benefits would occur if **Sub-alternatives 2a** and 2**c** were chosen but not **Sub-alternative 2b** since this sub-alternative would ban anchoring in Bajo de Sico during a fishing closure and under **Alternative 1 (No Action)**, anchoring in Bajo de Sico is banned throughout the year. Still, **Alternative 2** could be expected to yield greater long-term economic benefits than **Alternative 1 (No Action)** but like **Alternative 1 (No Action)**, the proposed federal regulations under **Alternative 2** are not compatible with regulations for Puerto Rico.

Under **Preferred Alternative 3, Preferred Sub-alternatives** 3**a** and 3**b**, no anchoring would be allowed at any time during the year in Abrir La Sierra Bank and Tourmaline Bank, respectively. That is, the proposed bans on anchoring in these two managed areas would be year-round. Anchoring is not currently allowed in Bajo de Sico. Choosing **Preferred Sub-alternatives 3a** and **3b** would yield higher long-term economic benefits than **Alternatives 1 (No Action)** and **Alternative 2** because anchoring would be disallowed for a longer period of time (the entire year), allowing coral reef communities the opportunity to repair and grow. This increases habitat health and fish stock health that use these habitats. Indirectly, long-run economic benefits would increase due to potentially higher landings and profits. Also, these sub-alternatives are compatible with Puerto Rico regulations regarding anchoring, which improve enforceability.

4.4.4 Direct and Indirect Effects on the Social Environment

This action would directly impact commercial, recreational, and subsistence fishermen who fish for Caribbean Council managed species in Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank and require the use of an anchor in order to fish safely for allowed species in an allowed method. Enforcement agents responsible for enforcing regulations in these areas would also be directly impacted. In addition, fishermen who don't fish in these seasonally closed areas, but depend on species which occur in these areas and are reliant on the corals for reef environments, could be indirectly impacted by this action.

Under **Alternative 1 (No Action)**, the anchoring of fishing vessels would be allowed in Abrir La Sierra Bank and Tourmaline Bank, but would continue to be prohibited in Bajo de Sico. Fishermen would continue to be allowed to anchor in Abrir La Sierra Bank and Tourmaline Bank and would be able to fish for whatever species of fish, if any, is allowed to be harvested in these areas as established in Actions 2, 3, and 5. However, under **Alternative 1 (No Action),** the coral populations would likely be negatively impacted by the continued ability to anchor in these areas. Negative impacts to corals can cause negative effects to fish populations who depend on them for habitat, and as a result can cause long-term negative effects to fishermen dependent on those fish populations.

Alternative 2 would prohibit anchoring during the seasonal closure established in Action 1 in Abrir La Sierra Bank (**Alternative 2a)**, Bajo de Sico (**Alternative 2b**), and Tourmaline Bank (**Alternative 2c**). If all sub-alternatives are selected, Bajo de Sico, Tourmaline Bank, and Abrir La Sierra Bank, would include consistent regulations regarding anchoring. However, regulations would remain inconsistent with Puerto Rico Commonwealth waters for part of the year, which could create enforcement issues and confusion for fishermen as to what is allowed in which area. Under **Alternatives 2a – 2c**, corals would receive increased protections from anchoring and it is likely that the positive impacts to corals can cause positive effects to fish populations who depend on them for habitat, and as a result can cause long-term positive effects to fishermen dependent on those fish populations. However, fishermen could be negatively impacted by the inability to anchor and safely fish for allowed species during the closed seasons in Bajo de Sico, Tourmaline Bank, and Abrir La Sierra Bank (as established in Actions 2, 3, and 5).

Preferred Alternative 3 would prohibit anchoring year-round in Abrir La Sierra Bank (**Preferred Alternative 3a)** and Tourmaline Bank (**Preferred Alternative 3b**). If all sub-alternatives are selected, Bajo de Sico, Tourmaline Bank, Abrir La Sierra Bank, and Puerto Rico Commonwealth waters would include consistent regulations regarding anchoring. However, if only one sub-alternative is selected, then regulations would remain inconsistent. Under **Preferred Alternatives 3a** and **3b**, corals would receive increased protection from anchoring and it is likely that the positive impacts to corals can cause positive effects to fish populations who depend on them for habitat, and as a result can cause long-term positive effects to fishermen dependent on those fish populations. However, fishermen could be negatively

impacted by the inability to anchor and safely fish for allowed species in Bajo de Sico, Tourmaline Bank, and Abrir La Sierra Bank (as established in Actions 2, 3, and 5).

4.4.5 Direct and Indirect Effects on the Administrative Environment

Alternative 1 is the no action alternative and would not change the anchoring prohibitions in the three managed areas. The administrative effects of **Alternative 1** are expected to be negative because it would not achieve consistency among the areas or compatibility with Puerto Rico regulations and therefore would continue current enforcement issues. Current enforcement issues have to do with differences in the regulations between the areas and the confusion to both enforcement agents and fishers about in which area and when anchoring is prohibited.

Alternative 2 proposes to prohibit anchoring for the duration of the seasonal closure established in Action 1. This alternative has the potential to alleviate some enforcement confusion, thus benefiting the administrative environment, by establishing consistent regulations among Abrir La Sierra Bank (**Sub-Alternative 2a**), Bajo de Sico (**Sub-Alternative 2b**), and Tourmaline Bank (**Sub-Alternative 2c**), federal waters. However, not all confusion will be avoided because each sub-alternative under **Alternative 2** would still be incompatible with Puerto Rico Commonwealth waters.

Preferred Alternative 3 would be expected to benefit the administrative environment the most. Both **Preferred Sub-Alternative 3a** and **Preferred Sub-Alternative 3b** would result in consistent regulations among the federal portions of the three areas as well as compatible regulations with Puerto Rico. This alternative would eliminate any confusion among fishers and enforcement agents about when and where anchoring is prohibited.

In summary, modifying the anchoring prohibitions as proposed in **Alternative 2** and **Preferred Alternative 3** would add a short-term administrative burden to promulgate the required regulations. The proposed alternatives would also result in additional short-term administrative burdens for law enforcement officers to implement the new changes in the regulations (e.g. training agents). However, **Alternative 2** would result in a number of positive long-term benefits by creating consistent regulations among the federal portions of these managed areas. **Preferred Alternative 3** would extend those benefits by achieving compatibility with Commonwealth anchoring regulations for these areas. Although developing regulations to achieve consistency and compatibility presents a short-term administrative burden, the long-term administrative effects of consistent regulations in federal waters and compatible regulations with Commonwealth waters are expected to be positive. Enforcement would be facilitated due to consistent regulations, which allows for straightforward application of the law and removes confusion as an excuse for non-compliance. This would likely translate into fewer false or unsupportable citations, more effective identification and prosecution of actual violations, less wasted time in the legal system, and better understanding and compliance by the fishers.

4.5 Action 5: Modify Highly Migratory Species Fishing Activities

4.5.1 Direct and Indirect Effects on the Physical Environment

Management actions that affect the physical environment mostly relate to the interactions of fishing gear with the sea floor. Action 5 would apply only to fishing activities for Atlantic HMS, including swordfish, billfish (blue marlin, white marlin, sailfish, and roundscale spearfish), tunas (bluefin, bigeye, albacore, yellowfin, and skipjack), and most species of sharks.

Alternative 1 is the no action alternative and would retain the current fishery management regulations specified for Atlantic HMS in Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. The current regulations for Council-managed species at 50 CFR §622 prohibit all bottom-tending gear (pots, traps, bottom longlines, gillnets or trammel nets) year-round in the three areas. Under current HMS regulations, found at 50 CFR §635, bottom longline gear is prohibited year-round only in Abrir La Sierra Bank and Tourmaline Bank, but not in Bajo de Sico. While there are other recreational and commercial federal HMS fishery management measures that apply in the U.S. Caribbean, there are no other HMS management measures exclusively specific to these three areas. So, although the Council has also prohibited all "fishing" during the closed seasons for Abrir La Sierra Bank and Tourmaline Bank, there are not compatible regulations in the HMS regulations at 50 CFR §635 to prohibit that activity during the closed seasons. The overall effect of **Alternative 1** would be neutral because it would retain existing HMS regulations. Fishing for most HMS, including billfish and swordfish, occurs in the upper and mid-level water column, so there are currently minimal effects on the physical environment (benthic habitat) associated with most HMS fishing activities under the no action alternative. However, potential detrimental impacts to important benthic habitat could occur in Bajo de Sico due to the continued allowance of bottom longline gear to fish for HMS; although, there have been no bottom longlines sets in Bajo de Sico for the past ten years.

Preferred Alternative 2 would, upon request of the Council, prohibit HMS bottom longline gear year-round in the Bajo de Sico area. This alternative could help to achieve compatibility with current regulations at 50 CFR §622 prohibiting bottom-tending gears (pots, traps, bottom longlines, gillnets or trammel nets) when fishing for Council-managed species in Bajo de Sico, and would be consistent with HMS regulations at prohibiting bottom longline gear in Abrir La Sierra Bank and Tourmaline Bank. Enforcement within these areas could be improved because all bottom-tending gear would be prohibited year-round in all the areas, with no exception for HMS bottom longline gear in Bajo de Sico. Similarly, important benthic habitat in Bajo de Sico would be better protected by prohibiting bottom longline gear year-round in the area. This could improve stock rebuilding efforts for Council-managed reef fish. There could also be some beneficial impacts to HMS stock rebuilding, particularly sharks, however these are expected to be minimal because there have been no bottom longline sets in Bajo de Sico reported in HMS logbooks for the last ten years (2003 – 2012).

Alternative 3 would, upon request of the Council, prohibit all fishing for, and possession of, HMS in some or all of the three areas during the time period established in Action 1. The impacts of this alternative depend largely upon the decisions of the Council in Action 2. Currently, in the Council regulations at 50 CFR §622, all "fishing" is prohibited during the closed seasons in Abrir La Sierra Bank and Tourmaline Bank, but in Bajo de Sico, only fishing for and possession of Council-managed reef species is prohibited during the closed season. This means that, although the Council has prohibited "fishing" during the closed seasons for Abrir La Sierra Bank and Tourmaline Bank, there are not compatible regulations in the HMS regulations at 50 CFR §635 to prohibit that activity during the closed seasons. The HMS sub-alternatives in **Alternative 3** can be selected to achieve compatible regulations between HMS and Council regulations for the three areas. Non-compatible regulations could continue to affect enforcement within the areas because it would remain difficult to determine if vessels are fishing for HMS or for other species. Fishing for most HMS, including billfish and swordfish, occurs in the upper and mid-level water column, so there are currently minimal effects on the physical environment associated with most HMS fishing activities. HMS bottom longline gear is already prohibited year-round in Abrir La Sierra Bank and Tourmaline Bank, so any potential positive effect on the physical environment under this alternative would occur by prohibiting all fishing for HMS in Bajo de Sico during the closed season.

Preferred Alternative 4 would, upon request of the Council, prohibit all fishing for HMS in some or all of the three areas during the time period established in Action 1 with an exception that would allow only surface trolling, as defined at §635.21(a)(4)(iv), for all HMS. Similar to **Alternative 3**, the impacts of **Preferred Alternative 4** depend largely upon the actions chosen for Council-managed fishing activities. Currently, in the Council regulations at 50 CFR §622, all "fishing" is prohibited during the closed seasons in Abrir La Sierra Bank and Tourmaline Bank, but in Bajo de Sico only fishing for and possession of Council-managed reef species is prohibited during the closed season. The HMS sub-alternatives in **Alternative 4** can be selected to achieve compatible regulations between HMS and Council regulations for the three areas. Non-compatible regulations could continue to affect enforcement within the areas because it would be difficult to determine if vessels are fishing for HMS or for other species. If the Council prohibits fishing in some or all of the areas only for Council-managed reef species (with an exception that allows fishing for pelagics), and only surface trolling is allowed for HMS in the same areas, then **Preferred Alternative 4** would establish compatible regulations between HMS and Council regulations. If the Council and HMS establish compatible regulations, then enforcement within the areas would be improved. Fishing for most HMS, including billfish and swordfish, occurs in the upper and mid-level water column, so there are currently minimal effects on the physical environment associated with most HMS fishing activities. Under **Preferred Alternative 4**, pelagic longline gear, bottom longline gear, speargun fishing, and hook and line fishing for HMS that does not meet the definition of surface trolling would be prohibited during some or all of the three seasonal area closures. HMS bottom longline gear is already prohibited year-round in Abrir La Sierra Bank and Tourmaline Bank, so any potential positive effect on the physical environment under this alternative would occur by prohibiting all fishing for HMS in Bajo de Sico, with the exception of surface trolling , during the closed season. Adopting

Preferred Alternative 4 for Abrir La Sierra Bank and Tourmaline Bank would have a minimal impact on the physical environment, because most HMS fishing activity currently occurs in the upper to mid-level of the water column, but could help establish consistent regulations. Surface trolling gear has minimal impacts on important benthic habitat and, thus, this habitat would be protected. In summary, adopting **Preferred Alternative 4** for all three areas could help protect the physical environment in Bajo de Sico, provide consistent regulations, and have only minimal socio-economic impacts on HMS fishermen.

Alternative 5 would, upon request of the Council, allow fishing for BAYS tunas with speargun fishing gear in some or all of the three areas during the time period established in Action 1. Similar to **Alternatives 3 and 4**, the impacts of **Alternative 5** depend largely upon the actions chosen for Council-managed fishing activities. The HMS sub-alternatives in **Alternative 5** can be selected to achieve compatible regulations between HMS and Council regulations for the three areas. Non-compatible regulations could continue to affect enforcement within the areas because it would remain difficult to determine if vessels are fishing for HMS or for other species. If the Council prohibits fishing in some or all of the areas only for Council-managed reef species (with an exception that allows spearfishing for pelagics), and spearfishing is allowed for HMS in the same areas, then **Alternative 5** would establish compatible regulations between HMS and Council regulations. If the Council and HMS Management Division establish compatible regulations, then enforcement within the areas could be improved. Spearfishing for BAYS tunas occurs in the upper and mid-level water column, so there are minimal impacts on important benthic habitat associated with the activity. In summary, adopting **Alternative 5** for all three areas could continue to provide protection of the physical environment.

4.5.2 Direct and Indirect Effects on the Biological/Ecological Environment

For all of the alternatives under Action 5, NOAA's National Marine Fisheries Service (NMFS) anticipates only minor to neutral biological and ecological effects on HMS. These species often travel great distances, sometimes thousands of miles, in a single year and are not known to congregate or remain for any extended period of time in the waters of the managed areas that are small in size. The three areas being considered for modification are each 9 square (sq) nautical miles (nm). It is unlikely that prohibiting fishing for HMS (**Alternative 3**) or allowing only surface trolling for HMS (**Preferred Alternative 4**) during the closed seasons in areas ranging from 9 sq nm to a total of 27 sq nm will significantly impact populations of Atlantic tunas, billfish, swordfish, or sharks. In October 2013, there were 604 HMS Angling category permits issued to residences in Puerto Rico, and 18 HMS Charter/Headboat permits issued. Additionally, among commercial permit holders, there were 83 Atlantic Tunas General Category (as of October 2013), and in February 2014 there were 8 Swordfish General Commercial, and 2 Commercial Caribbean Small Boat permits issued in Puerto Rico. There are no HMS commercial permits issued in Puerto Rico that allow for the deployment of longline gear (i.e., shark, swordfish, and tuna limited access permits); although longline vessels from other U.S. ports could fish in the U.S. EEZ near Puerto Rico. Even so, no HMS longline sets have been reported for the past ten years in the three areas. Any HMS fishing activities that may have historically occurred in the three areas

during the closed seasons could occur just outside the areas perhaps with minimal change in catch per unit effort (CPUE). NMFS specifically requests comment from the public regarding the importance of these areas when fishing for HMS. Ecological impacts under **Alternatives 2**, **3**, **4, and 5** could be positive, but only to a minor extent, because important benthic habitat would be protected and enforcement capabilities would be improved. This could provide minor beneficial impacts to some HMS stocks, particularly sharks, which are more likely than other HMS to inhabit benthic areas. Maintaining the current HMS regulations in these areas (**Alternative 1**) could affect enforcement capabilities due to inconsistent regulations between Council-managed species and HMS.

4.5.3 Direct and Indirect Effects on the Economic Environment

The best available commercial fishing information indicates that there have been no HMS longline sets within Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank for the last decade. Commercial handgear information does not provide the location from which HMS were harvested. Similarly, recreational fishing information does not provide locational data other than to indicate the number of HMS landed in Puerto Rico. For this reason, NMFS is specifically seeking public comment from all HMS permit holders in Puerto Rico regarding the economic importance of the three areas, and the analyses provided below.

Alternative 1 is the no action alternative and would retain the current fishery management regulations specified for Atlantic HMS in Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. There would be no change in economic impacts on HMS fisheries, as this alternative would maintain current HMS regulations in these areas.

Preferred Alternative 2 would, upon request of the Council, prohibit HMS bottom longline gear year-round in the Bajo de Sico area. The current regulations for Council-managed species at 50 CFR §622 prohibit all bottom-tending gear (pots, traps, bottom longlines, gillnets or trammel nets) year-round in the three areas. However, under current HMS regulations, found at 50 CFR §635, bottom longline gear is prohibited year-round only in Abrir La Sierra Bank and Tourmaline Bank, but not in Bajo de Sico. This alternative could help to achieve the purpose and need of this amendment which is, in part, to establish consistent regulations between the three areas. NMFS does not anticipate any economic impacts on HMS fishermen associated with this alternative because there are no HMS permits issued to residents of Puerto Rico that authorize the deployment of bottom longline gear. Also, there have been no bottom longline sets in Bajo de Sico reported in HMS logbooks for the last ten years (2003 – 2012).

Alternative 3 would, upon request of the Council, prohibit all fishing for, and possession of, HMS in some or all of the three areas during the time period established in Action 1. The impacts of this alternative depend largely upon the decisions of the Council in Action 2. Under current HMS regulations,

fishing for HMS is allowed year-round in all three areas except that HMS bottom longline gear is prohibited year-round in Abrir La Sierra Bank and Tourmaline Bank. Currently, in the Council regulations, all "fishing" is prohibited during the closed seasons in Abrir La Sierra Bank and Tourmaline Bank, but in Bajo de Sico only fishing for and possession of Council-managed reef species is prohibited during the closed season. The HMS sub-alternatives in **Alternative 3** can be selected to achieve compatible regulations between HMS and Council regulations for the three areas.

All HMS permit holders that fish off the west coast of Puerto Rico could potentially be impacted by a seasonal prohibition on fishing for HMS in some or all of the areas. For HMS recreational fisheries, and some commercial HMS fisheries, this alternative could result in minor adverse economic impacts. In October 2013, there were 604 HMS Angling category permits issued to residences in Puerto Rico, and 18 HMS Charter/Headboat permits issued. Additionally, among commercial permit holders, there were 83 Atlantic Tunas General Category (as of October 2013), and in February 2014 there were 8 Swordfish General Commercial, and 2 Commercial Caribbean Small Boat permits issued in Puerto Rico. There are no HMS commercial permits issued in Puerto Rico that allow for the deployment of longline gear (i.e., shark, swordfish, and tuna limited access permits). Also, no HMS longline sets have been reported for the past ten years in the three areas.

In recent years, between three to nine HMS fishing tournaments have occurred annually from ports on the west coast of Puerto Rico, including Boqueron, Cabo Rojo, and Mayaguez. Fishing tournaments can be economically important to many fishing communities. Unfortunately, there is no other information available which provides the precise location of recreational HMS fishing activity. It is very possible that some recreational HMS fishing activity has historically occurred in Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank, as these are known to be productive fishing areas. One notable observation is that, in 2013, all three registered HMS fishing tournaments on the west coast of Puerto Rico were conducted during the month of October. This could indicate that October is an important month for HMS fishing activities in the area. If the closed seasons were to include October, economic impacts under **Alternative 3** could be negative to a minor extent. However, due to the highly migratory nature of these species, the impacts are expected to be minor because the areas are relatively small in size (9 sq nm). HMS fishing activities could occur just outside the areas during the closed seasons with a potential minimal change in CPUE.

Preferred Alternative 4 would, upon request of the Council, prohibit all fishing for HMS in some or all of the three areas during the time period established in Action 1 with an exception that would allow only surface trolling, as defined at §635.21(a)(4)(iv), for all HMS. Similar to **Alternative 3**, the impacts of **Preferred Alternative 4** depend largely upon the actions chosen for Council-managed fishing activities. The HMS sub-alternatives in **Preferred Alternative 4** can be selected to achieve compatible regulations between HMS and Council regulations for the three areas. If compatible regulations are established, then enforcement within the areas could be improved.

All HMS permit holders that fish off the west coast of Puerto Rico could potentially be impacted by a seasonal prohibition on fishing for HMS in some or all of the areas. However, providing an exception in **Preferred Alternative 4** that allows for surface trolling could mitigate negative economic impacts. Fishing for several species of tuna and billfish can effectively occur using surface trolling techniques. The vast majority of HMS permits issued in Puerto Rico are recreational HMS Angling, charter/headboat, or commercial handgear permits. Because these permits allow for surface trolling, economic impacts under **Preferred Alternative 4** would remain largely unchanged for these participants. Fishing for HMS with pelagic longline and buoy gear would be prohibited in the selected areas during the seasonal closures, but there have been no reported sets by either gear sector in the areas for the past ten years. Thus, only minor economic impacts are anticipated for these sectors. Hook-and-line fishing for HMS that does not meet the surface trolling definition would also be prohibited during the three seasonal area closures. This could affect some HMS fishing activities. However, due to the highly migratory nature of these species, the impacts are expected to be minor because the areas are relatively small in size (approximately 9 sq nm). HMS fishing activities that do not meet the definition of surface trolling could occur just outside the areas with a potential minimal change in CPUE. Overall, this alternative would continue to provide some HMS fishing opportunities for recreational and commercial handgear fishermen and allow for the conduct of economically important HMS fishing tournaments, while simultaneously protecting benthic habitat and the reef fish that seasonally aggregate in the three areas.

Alternative 5 would, upon request of the Council, allow fishing for BAYS tunas with speargun fishing gear in some or all of the three areas during the time period established in Action 1. Similar to **Alternatives 3 and 4**, the impacts of **Alternative 5** depend largely upon the actions chosen for Council-managed fishing activities. The HMS sub-alternatives in **Alternative 5** can be selected to achieve compatible regulations between HMS and Council regulations for the three areas. Non-compatible regulations could continue to affect enforcement within the areas because it would remain difficult to determine if vessels are fishing for HMS or for other species. If the Council prohibits fishing in some or all of the areas only for Council-managed reef species (with an exception that allows spearfishing for pelagics), and spearfishing is allowed for HMS in the same areas, then **Alternative 5** would establish compatible regulations between HMS and Council regulations. If the Council and HMS Management Division establish compatible regulations, then enforcement within the areas could be improved.

Under certain conditions, spearfishing for BAYS tunas can be effective. Many HMS permits issued in Puerto Rico are recreational HMS Angling and charter/headboat permits. Because these permits allow for spearfishing for BAYS tunas during the closed season, economic impacts under **Alternative 5** would remain largely unchanged for these participants. Overall, this alternative would continue to provide some HMS fishing opportunities for recreational fishermen, while simultaneously protecting benthic habitat and the reef fish that seasonally aggregate in the three areas.

4.5.4 Direct and Indirect Effects on the Social Environment

The best available commercial fishing information indicates that there have been no HMS longline sets within Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank for the last decade. Commercial handgear information does not provide the location from which the HMS were harvested. Similarly, recreational fishing information does not provide locational data other than to indicate the number of HMS that have been landed in Puerto Rico. For this reason, NMFS is specifically seeking public comment from all HMS permit holders in Puerto Rico regarding the social importance of the three areas, and the analyses provided below.

Alternative 1 is the no action alternative. There would be no change in social impacts on HMS fisheries, as this alternative would maintain current HMS regulations in Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. However, under the current regulatory situation, there may exist some confusion among HMS fishery participants regarding which activities are allowed or prohibited in these three areas because regulations differ between areas and species.

Preferred Alternative 2 would, upon request of the Council, prohibit HMS bottom longline gear year-round in the Bajo de Sico area. This alternative could help to achieve the purpose and need of this amendment which is, in part, to establish consistent regulations between the three areas. **Preferred Alternative 2** could also help to reduce confusion among HMS fishery participants by clarifying that all bottom longline gear is prohibited year-round in all three areas. Social impacts, either positive or negative, would be minor under this alternative because there are no HMS permits issued to residents of Puerto Rico that authorize the deployment of bottom longline gear. Also, there have been no bottom longline sets in Bajo de Sico reported in HMS logbooks for the last ten years (2003 – 2012).

Alternative 3 would, upon request of the Council, prohibit all fishing for, and possession of, HMS in some or all of the three areas during the time period established in Action 1. The impacts of this alternative depend largely upon the decisions of the Council in Action 2. The HMS sub-alternatives in **Alternative 3** could be selected to achieve compatible regulations between HMS and Council regulations for the three areas. Selecting compatible management measures between HMS and Council regulations for the three areas could reduce confusion among HMS permit holders regarding allowable activities.

All HMS permit holders that fish off the west coast of Puerto Rico, as described earlier in Chapter 3, could potentially be impacted by a seasonal prohibition on fishing for HMS in some or all of the areas. For HMS recreational fisheries, and some commercial HMS fisheries, this alternative could result in minor adverse social impacts.

In recent years, between three to nine HMS fishing tournaments have occurred annually from ports on the west coast of Puerto Rico, including Boqueron, Cabo Rojo, and Mayaguez. Fishing tournaments can be

socially important to many vessel owners, fishermen, marinas, fishing clubs, and fishing communities. Unfortunately, there is no other information available which provides the precise location of recreational HMS fishing activity. It is very possible that some recreational HMS fishing activity has historically occurred in Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank, as these are known to be productive fishing areas. As previously described, in 2013, all three registered HMS fishing tournaments on the west coast of Puerto Rico were conducted during the month of October, which may indicate that October is an important month for HMS fishing activities in the area. If the closed seasons were to include October, social impacts under **Alternative 3** could be negative to a minor extent. However, due to the highly migratory nature of these species, overall social impacts under this alternative are expected to be minor because the areas are relatively small in size (9 sq nm). HMS fishing activities could occur just outside the areas during the closed seasons.

Preferred Alternative 4 would, upon request of the Council, prohibit all fishing for HMS in some or all of the three areas during the time period established in Action 1 with an exception that would allow only surface trolling, as defined at §635.21(a)(4)(iv), for all HMS. Similar to **Alternative 3**, the impacts of **Preferred Alternative 4** depend largely upon the actions chosen for Council-managed fishing activities. Selecting compatible management measures between HMS and Council regulations for the three areas would reduce confusion among HMS permit holders regarding allowable activities.

All HMS permit holders that fish off the west coast of Puerto Rico could potentially be impacted by a seasonal prohibition on fishing for HMS in some or all of the areas. However, providing an exception in **Preferred Alternative 4** that allows for surface trolling could mitigate most negative social impacts. Fishing for several species of tuna and billfish can effectively occur using surface trolling techniques. The majority of HMS permits issued in Puerto Rico are recreational HMS Angling, charter/headboat, or commercial handgear permits. Because these permits allow for surface trolling, social impacts under **Preferred Alternative 4** would remain largely unchanged for these participants. Fishing for HMS with pelagic longline and buoy gear would be prohibited in the selected areas during the seasonal closures, but there have been no reported sets by either gear sector in the areas for the past ten years. Thus, only minor social impacts are anticipated for these sectors. Hook-and-line fishing for HMS that does not meet the definition of surface trolling would also be prohibited during the three seasonal area closures. This could affect some HMS fishing activities. However, due to the highly migratory nature of these species, the social impacts are expected to be minor because the areas are relatively small in size (9 sq nm). These activities could occur just outside the areas. Overall, this alternative would provide some HMS fishing opportunities for recreational and commercial handgear fishermen and allow for the conduct of socially important HMS fishing tournaments, while simultaneously protecting benthic habitat and the reef fish that seasonally aggregate in the three areas.

Alternative 5 would, upon request of the Council, allow fishing for BAYS tunas with speargun fishing gear in some or all of the three areas during the time period established in Action 1. Similar to **Alternatives 3 and 4**, the impacts of **Alternative 5** depend largely upon the actions chosen for Council-

managed fishing activities. The HMS sub-alternatives in **Alternative 5** can be selected to achieve compatible regulations between HMS and Council regulations for the three areas. Non-compatible regulations could continue to affect enforcement within the areas because it would remain difficult to determine if vessels are fishing for HMS or for other species. If the Council and HMS Management Division establish compatible regulations, then enforcement within the areas could be improved and confusion among fishermen could be reduced. Many HMS permits issued in Puerto Rico are recreational HMS Angling and charter/headboat permits. Because these permits allow for spearfishing for BAYS tunas during the closed season, social impacts under **Alternative 5** would remain largely unchanged for these participants. Overall, this alternative would continue to provide some HMS fishing opportunities for recreational fishermen, while simultaneously protecting benthic habitat and the reef fish that seasonally aggregate in the three areas.

4.5.5 Direct and Indirect Effects on the Administrative Environment

Alternative 1 is the no action alternative. Administrative effects from this alternative are expected to be negative because it would not achieve compatibility between the regulations established for Council-managed reef species at 50 CFR §622 and the HMS regulations found at 50 CFR §635. Depending upon the measures selected by the Council, enforcement within these areas could continue to be affected because it would remain difficult to determine if vessels are fishing for HMS or for reef species.

Preferred Alternative 2 would prohibit HMS bottom longline gear year-round in the Bajo de Sico area. This alternative would benefit the administrative environment. The administrative effects of having compatible regulations between Council-managed species and HMS in the three areas west of Puerto Rico are expected to be positive because it would facilitate the enforcement of such regulations. Enforcement within these areas could be improved because all bottom-tending gear would be prohibited year-round, with no exception for HMS bottom longline gear in Bajo de Sico. This would remove confusion and clarify allowable and prohibited activities in the areas.

Alternative 3 would, upon request of the Council, prohibit all fishing for, and possession of, HMS in some or all of the three areas during the time period established in Action 1. The administrative impacts of this alternative depend largely upon the decisions of the Council in Action 2. If the Council chooses to prohibit all fishing in some or all of the three areas, the HMS sub-alternatives in **Alternative 3** could be selected to achieve compatible regulations between HMS and Council regulations. Selecting compatible management measures between HMS and Council regulations could facilitate enforcement by reducing confusion regarding allowable activities.

Preferred Alternative 4 would, upon request of the Council, prohibit all fishing for HMS in some or all of the three areas during the time period established in Action 1 with an exception that would allow only surface trolling, as defined at §635.21(a)(4)(iv), for all HMS. Similar to **Alternative 3**, the impacts of **Preferred Alternative 4** depend largely upon the actions chosen for Council-managed fishing activities.

If the Council chooses to prohibit only fishing for Council-managed reef species in some or all of the three areas, but allows fishing for pelagics then the HMS sub-alternatives in **Preferred Alternative 4** could be selected to achieve compatible regulations between HMS and Council regulations. Selecting compatible management measures between HMS and Council regulations could facilitate enforcement by reducing confusion regarding allowable activities. The allowance for surface trolling and speargun fishing in **Preferred Alternative 4** could present more of an administrative burden than the total prohibition on fishing described in **Alternative 3**. However, there are unique characteristics associated with surface trolling (boat in constant motion at speeds in excess of four knots with a visible wake, etc.) that should make this activity distinguishable from disallowed fishing activities.

Alternative 5 would, upon request of the Council, allow fishing for BAYS tunas with speargun fishing gear in some or all of the three areas during the time period established in Action 1. **Alternative 5** could be selected to achieve compatible regulations between HMS and Council regulations. Selecting compatible management measures between HMS and Council regulations could facilitate enforcement by reducing confusion regarding allowable activities. An allowance for speargun fishing for BAYS tunas in **Alternative 4** could present more of an administrative burden than a total prohibition on HMS fishing described in **Alternative 3**. However, there are unique characteristics associated with speargun fishing (person is physically in water when speargun is fired, etc.) that should make this activity discernible from disallowed fishing activities.

4.6 Action 6: Modify Spearfishing Activities

4.6.1 Direct and Indirect Effects on the Physical Environment

Spear is a selective gear and divers who utilize spear have the ability to avoid contact with coral and other benthic habitat. However, sometimes divers can unintentionally interact with habitat, including touching with their hands, body, gear, and fins or by breaking corals. Such touching can remove mucus, which may leave the coral susceptible to disease, bacteria, or algae (Talge 1991). Replacing this lost mucus and repairing tissue damage requires corals to spend energy that could otherwise be used for growth and feeding (Talge 1991; Hawkins and Roberts 1993). But corals can usually replace lost mucus within 24 hours so this disruption isn't cause for significant damage. Talge (1991) found that weekly touching of corals had no detectable lasting impacts to the health of the 11 coral species studied. Conversely, Hawkins and Roberts (1993) found that heavy trampling by divers appears to alter coral population structure on reefs. Coral colonies in trampled areas were smaller on average than in untrampled areas and there were fewer coral colonies and lower hard coral cover.

Diver interactions may also result in an interruption of reproduction. On the other hand, breakage of branching corals can be a means of asexual reproduction when large enough pieces fall into suitable areas and continue to grow. Otherwise, such breakage is harmful when fragments are reduced to a size too small to survive or reproduce (Talge 1991; Hawkins and Roberts 1993).

Hawkins et al. (1999) reported that studies have shown significant loss of coral cover and high incidences of colony damage at diving intensities greater than 5,000-6,000 dives per site, per year. If management is intended to maintain current coral cover, then diving at intensities below 6,000 dives per site, per year, should not be considered harmful. If diving activities result in any damage, the newly available area could be colonized by rapidly growing branching species, thus resulting in fairly consistent coral coverage but higher species diversity. However, if maintaining the characteristics of a reef, including species diversity, is the goal, then allowable diving pressure may need to be considerably less, particularly in areas subject to additional stresses or with low levels of natural disturbance (Hawkins et al. 1999).

As such, no significant direct effects on the physical environment of the managed areas are anticipated. Under current regulations (**Alternative 1**) and proposed modifications to the spearfishing regulations (**Alternative 2**, **Preferred Alernative 3**, and **Alternative 4**), the potential to damage the coral reef populations from fishing activities within the areas would remain the same. Each alternative would only regulate spearfishing, not the actual activity of diving. There would be no restrictions on diving recreationally. If divers were to incidentally interact with the corals, the effects would be minor.

A possible indirect impact could be the potential for interactions between coral and anchors. Boats may drop anchors to ensure the boat remains stationary while divers are below the surface spearfishing. However, proposed regulations in Action 4 may prohibit anchoring within the managed areas. If the

Council chooses to prohibit anchoring, the potential indirect impacts of anchor interactions with corals will be reduced.

4.6.2 Direct and Indirect Effects on the Biological/Ecological Environment

Although spear is a selective gear, and there is a low probability of bycatch, spearfishing may have chronic negative indirect effects on the fish populations located within an area. Studies demonstrate that areas protected from spearfishing have higher abundance and larger sizes of certain individuals than those areas where spear is allowed (Lloret et al. 2008). Common practice among spear fishers is to target the largest individual of a prized species thus causing a potential decrease in the average size of that species (Sluka and Sullivan 1998). By removing the larger fish, only smaller individuals are left to spawn, resulting in a decrease in size and age at sexual maturation, as well the average size of the population as a whole (Sluka and Sullivan 1998). Groupers, in particular, are especially vulnerable because many species are protogynous hermaphrodites, changing from females to males as they mature (Sluka and Sullivan 1998). If larger grouper are preferentially targeted, the sex ratio likely will be skewed toward smaller females resulting in reduced fertilization rate and a general reduction in spawning success.

Alternative 1 is the no action alternative and would maintain the current spearfishing regulations. Currently, there are no restrictions on the use of spear to harvest species within Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. This alternative would continue to allow fishers to use spear to harvest marine resources. There are no direct adverse impacts to the biological environment anticipated. Allowing the use of spear would not result in an increase in fishing pressure to the marine resources. However, Action 2 proposes to prohibit fishing for and possession of Council-managed reef fish, so Action 2 would be in direct conflict with **Alternative 1**. If the Council prohibits the possession of Council-managed reef fish (Action 2, Preferred Alternative 3), fishers would not be allowed to possess Council-managed reef fish, regardless of the spearfishing regulations. Consequently, reef fish would still be afforded protection under **Alternative 1**.

Alternative 2 would have similar direct effects to the biological environment as **Alternative 1**, however, under **Alternative 2**, the use of spear to fish for Council-managed reef fish would be explicitly prohibited during the seasonal closure established in Action 1. Under these regulations, fishers would not be able to use spear to harvest Council-managed reef fish during the seasonal closure, thus providing protection to the reef fish population. Fishers could, however, still use spear to harvest other species not managed by the Council and could still use spear to harvest Council-managed reef fish outside of the closure period. Since spear is a highly selective gear, fishers could target specific fish that are not presently spawning and in that way not interfere with spawning aggregations.

Preferred Alternative 3 and **Alternative 4** would prohibit spearfishing for all non-HMS-managed species, including Council-managed reef fish and coastal migratory pelagics, during the seasonal closure

and throughout the year, respectively. Spearfishing for HMS species is addressed in Action 5. Compared to the other alternatives, these alternatives would provide the most protection to the biological environment because it protects all non-HMS species from directed spearfishing efforts. Alternative 4 would provide the greatest protection because it eliminates spearfishing throughout the year.

Because spearfishing is so selective, and the harvest of ESA-listed species is prohibited, it is unlikely interactions between fishermen/gear and those species will occur. Therefore, the biological benefits of each alternative to ESA-listed species are likely to be the same.

4.6.3 Direct and Indirect Effects on the Economic Environment

With a low probability of bycatch and the ability to be selective, spearfishing may be less harmful to the biological stock than other fishing gear. However, as stated above, spearfishing may be harmful to certain species since larger fish are typically targeted. This can have indirect long-term economic drawbacks for fishermen and society.

Alternative 1 retains the existing spearfishing regulations in each of the Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank areas. This would allow for the continued use of spear for fishing in the managed areas. This is the least restrictive of the alternatives presented under Action 6 and therefore provides the opportunity for the greatest short-term economic benefits. **Alternative 2** prohibits spearfishing for Council-managed reef fish during the seasonal closure established in Action 1 for each of the three managed areas. **Preferred Alternative 3** prohibits spearfishing for all non-HMS-managed species, including Council-managed reef fish and coastal migratory pelagics during the seasonal closure established in Action 1 for each of the three areas. **Alternative 4** prohibits spearfishing for all non-HMS-managed species year-round for each of the three areas. This is the most restrictive of the four alternatives and would have the least short-term economic benefits but likely the greatest long-term biological and therefore economic benefits.

4.6.4 Direct and Indirect Effects on the Social Environment

Alternative 1 would retain the existing spearfishing regulations in Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. **Alternative 1** would continue to allow fishermen to use a spear to harvest reef fish and coastal migratory pelagics. However, whether fishermen are allowed to spear fish for these species during the seasonal closure for each area will depend on the alternative selected in Action 2. For example, the current preferred alternatives (**Preferred Sub-Alternatives 3a-b**) for Action 2 would include prohibiting fishing for Council-managed reef fish in Abrir La Sierra Bank and Tourmaline Bank during the seasonal closure established in Action 1. The possession of Council-managed reef fish in Abrir La Sierra Bank and Tourmaline Bank during the seasonal closure would also be prohibited. In regards to

Bajo de Sico, fishing for and possession of Council-managed reef fish would still be prohibited under the current preferred alternatives in Action 2. Therefore, under **Alternative 1** and the current preferred alternatives for Action 2, spearfishing would be allowed during the open season (if any, depending on the selected alternative in Action 1). The current preferred alternatives for Action 1 are Sub-Alternatives 3a-b which include an open season from April 1-September 30) in Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank.

Alternative 1 would include the same impacts to spear fishermen as those expected to be experienced under the selected alternative in Action 2. In addition, the same issues with enforcement would be expected to be experienced under **Alternative 1** as under the selected alternative in Action 2.

Alternative 2 would prohibit spearfishing for Council-managed reef fish during the seasonal closure established in Action 1 in Abrir La Sierra Bank (**Sub-Alternative 2a**), Bajo de Sico (**Sub-Alternative 2b**), and Tourmaline Bank (**Sub-Alternative 2c**). As with **Alternative 1**, **Alternative 2** is dependent on the selection of an alternative in Action 2 to determine whether there is an already existing closure for Council-managed reef fish in the three areas during the closed season. If any of the alternatives in Action 2 are selected (including the no action alternative), reef fish would already be prohibited from being fished in all three areas during their seasonal closures; therefore **Sub-Alternatives 2a-c** would be expected to have no impact on spear fishermen. Under **Sub-Alternatives 2a-c**, spear fishermen would continue to be allowed to use a spear to fish for Council-managed reef fish during the open season in Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. They would also continue to be allowed to spear fish for coastal migratory pelagics year round in all three areas. This continuation of allowing spear fishing for coastal migratory pelagics in the three areas, but not allowing spear fishing for Council-managed reef fish, could continue to create some negative issues for enforcement as agents might not be able to discern whether fishermen are spearing allowable species.

Preferred Alternative 3 and **Alternative 4** would prohibit spearfishing for all species including Council-managed reef fish and coastal migratory pelagics; however **Preferred Alternative 3** would prohibit spearfishing during the closed season and **Alternative 4** would prohibit spearfishing year round.

As with **Alternatives 1** and **2**, **Preferred Alternative 3** is dependent on the selection of an alternative in Action 2 to determine whether there is an already existing closure for Council-managed reef fish in the three areas of Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank during the closed season. For example, the current preferred alternatives (Preferred Sub-Alternatives 3a-b) for Action 2 would include prohibiting fishing for Council-managed reef fish in Abrir La Sierra Bank and Tourmaline Bank during the seasonal closure established in Action 1. In regards to Bajo de Sico, fishing for and possession of Council-managed reef fish would still be prohibited under the current preferred alternatives in Action 2. Therefore, under **Preferred Sub-Alternative 3a-c** and the current preferred alternatives for Action 2, spear fishermen who harvest coastal migratory pelagics are expected to be negatively impacted because spear fishing for these species would be prohibited during the seasonal closure in Abrir La Sierra Bank,

Bajo de Sico, and Tourmaline Bank. If all sub-alternatives are selected, regulations would be consistent between the three seasonally closed areas with spear fishing prohibited for all non-HMS species, including Council-managed reef fish and coastal migratory pelagics in each area during the closed season. This could contribute to an increase in ease in enforcement by enforcement agents and an increase in ease in understanding and following regulations by fishermen. However, if only one sub-alternative is selected then these positive effects would likely not occur because regulations would remain inconsistent.

If all the sub-alternatives (**Sub-Alternative 4a-c**) are selected, **Alternative 4** is not dependent on the selection of an alternative in Action 2 to determine whether there is an already existing closure for Council-managed reef fish in the three areas during the closed season because spearfishing for all non-HMS species, including Council-managed reef fish and coastal migratory pelagics, would be prohibited year round. The selection of all three sub-alternatives would be expected to include the greatest negative impacts to spear fishermen as they would not be able to spearfish for reef fish or coastal migratory pelagics at all during the year in the three areas. However, if not all sub-alternatives are selected then negative impacts to spear fishermen in the particular area not selected (**Sub-Alternative 4a** for Abrir La Sierra Bank, **Sub-Alternative 4b** for Bajo de Sico, and **Sub-Alternative 4c** for Tourmaline Bank) would be less severe because they would be allowed to spear fish for at least part of the year (assuming that a seasonal closure including only part of the year was selected in Action 1). However, if all sub-alternatives are not selected, regulations would be inconsistent between the three seasonally closed areas. This could contribute to difficulty in enforcement by enforcement agents and an increase in difficulty in understanding and following regulations by fishermen. Conversely, if all sub-alternatives are selected then the opposite would likely occur, with resulting positive effects from consistent regulations.

4.6.5 Direct and Indirect Effects on the Administrative Environment

Alternative 1 is the no action alternative and would not change the spearfishing regulations in the three managed areas. Spearfishing would still be allowed year-round in Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. The administrative effects of **Alternative 1** are expected to be negative because it would not achieve consistency among the areas and therefore would continue current enforcement issues. Current enforcement issues have to do with differences in the regulations between the areas and the confusion to both enforcement agents and fishers about in which area and when spearfishing is prohibited.

Alternative 2, Preferred Alternative 3, and **Alternative 4** would have in common their direct and indirect effects on the administrative environment. Each of the alternatives gives the Council the option to create consistent regulations among the three areas, thus alleviating some enforcement confusion and benefiting the administrative environment.

Under **Alternatives 2-4**, the Council has the option to select the alternative for one, two, or all three of the managed areas. Selecting **Sub-Alternatives a**, **b**, and **c** within any of those alternatives would result in consistent regulations among the three managed areas in federal waters. However, if the Council chooses a sub-alternative for one area and not the others, inconsistencies between the three areas would remain. As an example, if the Council selects **Sub-Alternative 4a**, **4b,** and **Sub-Alternative 3c**, Bajo de Sico and Abrir La Sierra Bank would have consistent regulations while Tourmaline Bank regulations would be inconsistent with those two. This would not facilitate enforcement or avoid confusion among constituents.

In summary, modifying the spearfishing regulations as proposed in **Alternatives 2-4** of Action 6 would add a short-term administrative burden to promulgate the required regulations. **Alternatives 2-4** would also result in additional short-term administrative burdens for law enforcement officers to implement the regulatory changes (e.g. training agents). However, consistent regulations would result in a number of positive long-term benefits by alleviating confusion among enforcement officers and user groups. Although developing regulations to achieve consistency presents an administrative burden, the net administrative effects of establishing consistent harvest regulations in federal waters are expected to be positive. Enforcement would be facilitated due to consistent regulations, which allows for straightforward application of the law and removes confusion as an excuse for non-compliance. This would likely translate into fewer false or unsupportable citations, more effective identification and prosecution of actual violations, less wasted time in the legal system, and better understanding and compliance by the fishers.

4.7 Cumulative Effects Assessment

As directed by the Council on Environmental Quality (CEQ) regulations, federal agencies are mandated to assess not only the direct and indirect impacts, but also the cumulative impacts of proposed actions. The CEQ regulations define a cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions." Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 C.F.R. 1508.7). Cumulative effects can either be additive or synergistic. A synergistic effect occurs when the combined effects are greater than the sum of the individual effects.

This section uses an approach for assessing cumulative effects based upon guidance offered by the CEQ publication - Considering Cumulative Effects Under the National Environmental Policy Act (1997). The report outlines 11 items for consideration in drafting a cumulative effects assessment (CEA) for a proposed action.

1) Identify the significant cumulative impacts issues associated with the proposed action and define the assessment goals.

The 1997 CEQ cumulative impacts guidance states this step is accomplished through three activities as follows:

I. The direct and indirect effects of the proposed action (Chapter 4);
II. Which resources, ecosystems, and human communities are affected (Chapter 3); and
III. Which effects are important from a cumulative effects perspective (information revealed in this CEA).

2) Establish the geographic scope of the analysis.

The general areas affected by this action and analyzed in this CEA are the federal waters of the U.S. Caribbean. These waters extend off Puerto Rico from 9 nautical miles (nm) to 200 nm and from 3 nm to 200 nm off the U.S. Virgin Islands (USVI). The specific areas that would be affected by the actions in this regulatory amendment are three managed areas located off the west coast of Puerto Rico (Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank). Both Bajo de Sico and Tourmaline Bank include portions in federal waters as well as in Puerto Rico Commonwealth waters. The Bajo de Sico area consists of about 60% federal waters, while the Tourmaline Bank area consists of approximately 40% federal waters. The actions proposed in this document, and the analyses associated with those proposed actions, only pertain to the federal portions of these areas. However, if the proposed actions in this amendment are approved by the Secretary of Commerce, the Council will coordinate with the government of Puerto Rico to implement compatible regulations. Managed resources, non-target species, habitat, and protected species present in federal waters of the U.S. Caribbean are also within this geographic scope.

The immediate areas affecting humans would include fishing communities of Puerto Rico, in particular fishing communities on the west coast of the island. These are discussed in Sections 3.3. A detailed description of the geographic range for species primarily affected by this regulatory amendment can be found in Section 3.2. The ranges of affected protected species are described in Section 3.2.2.

3) Establish the timeframe for the analysis.

The timeframe for the CEA should take into account historical efforts to manage reef fish, spiny lobster, and HMS in Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank, as well as future considerations if this regulatory amendment and its subsequent regulation are approved and implemented by NMFS. The timeframe for the CEA begins with the implementation of the three seasonally closed areas. Tourmaline Bank was first established in 1993 through Amendment 2 to the Fishery Management Plan (FMP) for the Reef Fish Fishery of Puerto Rico and the USVI (Reef Fish FMP; CFMC 1993). In 1996, Regulatory Amendment 2 to the Reef Fish FMP (CFMC 1996) modified the size of Tourmaline Bank and established Abrir La Sierra Bank and Bajo de Sico.

Long-term evaluation is needed to determine if management measures have the intended effect of facilitating enforcement in the Puerto Rico management area and improving the health of spawning aggregations.

4) Identify the other actions affecting the resources, ecosystems, and human communities of concern.

The following are some past, present, and future actions that affect Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank.

<u>Past</u>

Reef Fish Amendment 2 (CFMC 1993) established Tourmaline Bank. Tourmaline Bank was identified as a spawning aggregation area for red hind. In order to protect declining reef fish resources, Tourmaline Bank was closed to fishing from December 1 through the end of February. Because aggregating fish are highly susceptible to capture by a wide range of gears (e.g. hook-and-line, trap, and spears), the Council prohibited all fishing activities.

Reef Fish Regulatory Amendment 2 (CFMC 1996) modified the size of Tourmaline Bank in order to open up the sandy areas that were previously closed. Regulatory Amendment 2 also established Abrir La Sierra Bank and Bajo de Sico as spawning aggregation areas for red hind. As such, all fishing activities were prohibited within those two areas from December 1 through the end of February, each year.

Reef Fish Amendment 3 (CFMC 2005; Caribbean SFA Amendment) was implemented to address required provisions of the Magnuson-Stevens Fishery Conservation and Management Act. This

amendment prohibited the use of bottom tending gear (traps, pots, gillnets, trammel nets, bottom longlines) in the seasonally closed areas including Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank.

Reef Fish Regulatory Amendment 3 (CFMC 2010) increased the seasonal fishing closure of Bajo de Sico from three months to six months (October 1 through March 31) to provide greater protection of commercially important reef fish. Additional modifications allowed fishing for spiny lobster and HMS within Bajo de Sico. Under the new regulations, fishing for and possession of Council-managed reef fish within the federal portion of Bajo de Sico is prohibited.

Present and Reasonably Foreseeable Future

The physical, biological, social, economic, and administrative effects of modifying the seasonal closures of Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank are analyzed in Chapter 4 of this document.

A proposal to develop FMPs specific to each island or island group (e.g., Puerto Rico, St. Croix, St. Thomas/St. John) is currently under consideration. This action could affect the way reef fish and spiny lobster are managed in the U.S. Caribbean, as management would be tailored to each island or island group.

The Council is also considering a proposal to develop a comprehensive amendment to the U.S. Caribbean FMPs to adjust the buffer reduction applied to the overfishing limit or acceptable biological catch to derive the ACL for managed species. The Council is considering development of a control rule that would modify the buffer reduction based upon the overfishing status determination made annually by NMFS, with a 15% reduction being applied if the fishery management unit (FMU) is determined to be subject to overfishing and a 10% reduction being applied if the FMU is determined to not be subject to overfishing.

5) Characterize the resources, ecosystems, and human communities identified in scoping in terms of their response to change and capacity to withstand stress.

In terms of the biophysical environment, the resources and ecosystems identified in earlier steps (e.g., steps 1 and 2) of the CEA are the reef fish, spiny lobster, and HMS species directly affected by the regulations, and those species (e.g. *Acropora* spp. and sea turtles) that are indirectly affected by the regulations. The fishing communities that would be directly impacted are commercial, recreational, and subsistence fishermen who fish for Council-managed species in Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. Enforcement agents responsible for enforcing regulations in these areas would also be directly impacted. In addition, fishermen who don't fish in these seasonally closed areas, but depend on species which occur in these areas and are protected during the closures, could be indirectly impacted by this action.

Information on the physical, biological, ecological, social, and economic environments is provided in Chapter 3 of this document. The impacts and capacity to withstand stress of the biological and human communities is provided in Chapter 4 of this document.

6) Characterize the stresses affecting these resources, ecosystems, and human communities and their relation to regulatory thresholds.

This section examines whether resources, ecosystems, and human communities are approaching conditions where additional stresses could have an important cumulative effect beyond any current plan, regulatory, or sustainability threshold (CEQ 1997). Sustainability thresholds can be identified for some resources, which are levels of impact beyond which the resources cannot be sustained in a stable state. Other thresholds are established through numerical standards, qualitative standards, or management goals. This CEA should address whether thresholds could be exceeded because of the contribution of the proposed action to other cumulative activities affecting resources.

Fish species that form spawning aggregations are at greater risk of overexploitation due to their reproductive strategy, which includes long distance migrations, aggregating at high densities for prolonged periods, and predictability of aggregations in space and time. Aggregations have historically been viewed as opportunities for efficiently catching large numbers of fish rather than as important components of the species' life history that must be carefully and conservatively managed. Moreover, technological advances make aggregations increasingly easy to locate and target. Demand for reef fish is increasing due to market forces and growing exports (Sadovy et al. 2008).

Overfishing of spawning aggregations has been suggested to result in a number of detrimental impacts to reef fish species, including: reduced age at sexual maturity; a decrease in stock size, mean length, and recruitment; diminished density and biomass; and changes in sex-ratio (ratios of females to males within an aggregation). One immediate consequence of a shift in sex ratio is to lower effective population size, with cascading effects on genetic factors such as inbreeding, genotypic diversity, and population structuring (Ward et al. 2002). Sex ratio effects are also relevant to sex-changing species. In certain protogynous groupers that form spawning aggregations (such as red hind), sex ratios during aggregation periods may be an important cue for sex change, since this is the only time when adult males and females are known to come together in significant numbers (Sadovy de Mitcheson and Erisman 2012). One of the major goals in using closed areas to manage coral reef fisheries is the protection of a critical spawning-stock population to ensure recruitment supply to fished areas via larval dispersal. Another objective is the maintenance or enhancement of yields in areas adjacent to reserves by adult movements (Russ and Alcala 1996).

Stresses affecting reef fish and spiny lobster also include habitat quality and anthropogenic threats (e.g., habitat loss and degradation, sedimentation, pollution, water quality, overharvest, exploitation of spawning aggregations). Reef fish and spiny lobster greatly depend on coral reefs for basic survival needs

(e.g. shelter, food, and reproduction). Any changes in coral health will affect long-term viability of these species. Environmental changes (e.g., potential threats from climate change, ocean acidification) can also affect reef fish and spiny lobster populations.

Environmental changes (e.g., potential threats from climate change, ocean acidification) can also affect fishery populations, protected resources, and the people and communities that depend on those resources. New and recent information about climate change has begun to shed light on how global climate change will affect, and is already affecting, reef fish, spiny lobster, queen conch, and coral resources. Climate change is one of the most important environmental issues to arise in the past few decades and promises to remain so for the foreseeable future (Delach et al. 2014). Climate change can affect marine ecosystems through ocean warming by increased thermal stratification, changes to upwelling patterns, sea level rise, increases in wave height and frequency, loss of sea ice, and increased risk of diseases in marine biota, among other things. Potential vulnerabilities for coastal zones include increased shoreline erosion leading to alteration of the coastline, loss of coastal wetlands, and changes in the profiles of fish and other marine life populations (Lorde et al. 2013). Changes in ocean temperatures have been linked to shifting fish stock distributions and abundances in many marine ecosystems, and these impacts are expected to increase in the future (NMFS 2014). Any of these could affect the local or regional seafood output and thus the local economy (Carter et al. 2014). In the U.S. Caribbean region, as well as along the southeastern U.S. continental shelf and the Gulf of Mexico, the major climate induced ecosystem concerns are: (1) Threats to coral reef ecosystems: coral bleaching, disease, and ocean acidification; (2) Threats to habitat from sea level rise – loss of essential fish habitat; and (3) Climate induced changes to species phenology and distribution (Osgood 2008).

Climate variability is also a factor that needs to be considered when addressing climate effects, and in the reasonable foreseeable future it may be far more influential than unidirectional climate change (B. Arnold, personal communication). For example, inter-annual or El Niño scale changes in the ocean environment may result in changes in the distribution patterns of migratory fishes and can affect reproduction and recruitment in other species (NOAA PFL Climate Variability and Marine Fisheries, http://www.pfeg.noaa.gov/research/climatemarine/cmffish/cmffishery.html, accessed June 2014). Additionally, cyclical water temperature patterns may result in relatively short-term (i.e., decadal) decreases in water temperature despite the evident long-term pattern of temperature increase (Figure 4.2.1). Such decadal-scale events may be far more influential with respect to fishery management regulations such as those included in this amendment than are long-term climate change events, because these decadal-scale events operate on the time frame of the fishery management action. Based on the pattern depicted in Figure 4.2.1, cyclical water temperature has peaked, and if the pattern holds then water temperature patterns in the next few decades may actually decrease despite the general increasing trend due to climate change.

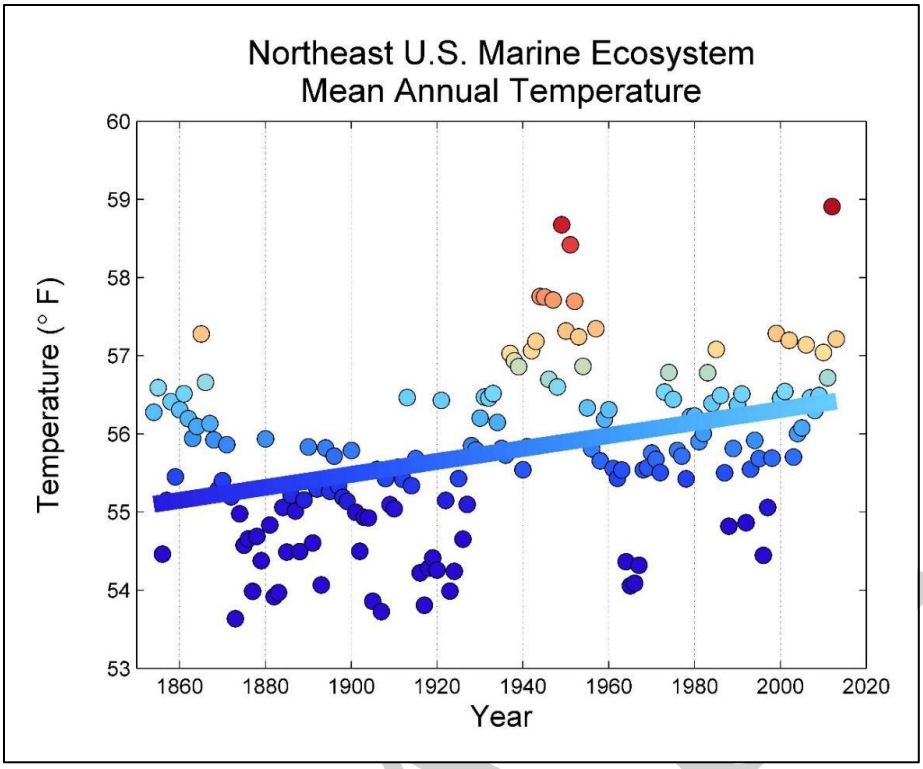


Figure 4.2.1. Long-term water temperature variability in waters of the northeastern United States, obtained from J. Hare using NOAA_ERSST_V3 data provided by the NOAA/OAR/ESRL PSD, Boulder, Colorado, USA, from their Web site at http://www.esrl.noaa.gov/psd/

Excess carbon dioxide (CO_2) dissolves into the ocean and is converted to corrosive carbonic acid, this is known as "ocean acidification" (Oceanus 2013). At the same time, the CO_2 also supplies carbon that combines with calcium already dissolved in seawater to provide the main ingredient for shells, calcium carbonate ($CaCO_3$) (Oceanus 2013). Some organisms directly deposit $CaCO_3$ along their inner shell walls, and consequently, depend on a sufficient ambient carbonate concentration to build shells successfully (UNEP 2009). Commercially valuable mollusks such as bivalves (e.g., scallops, oysters) and gastropods (e.g., conchs) use this method to build shells (Cooley and Doney 2009). Corals also depend on carbonate to build their skeletons. The net responses of organisms to rising CO_2 will vary depending on often opposing sensitivities to decreased seawater pH, carbonate concentration, and carbonate saturation state, and to elevated oceanic total inorganic carbon and gaseous CO_2 (Cooley and Doney 2009). Increased ocean acidity caused by elevated CO_2 could directly damage organisms by partially dissolving their shells (Oceanus 2013, https://www.whoi.edu/oceanus/viewArticle.do?id=52990) or by decreasing growth rates. Larval and juvenile organisms are particularly susceptible. To the extent that coral reef habitat becomes less available, fish that depend on coral reefs for food, shelter, and nursery habitat may be indirectly affected by changes in seawater pH (Harrould-Kolieb et al. 2010). Other species with more protective coverings on their shells and skeletons, such as crustaceans, temperate urchins,

mussels, and coralline red algae may be less vulnerable to decreasing seawater pH (Oceanus 2013). However, the specifics of how ocean acidification affects these species are not well understood.

In general, specific levels of impacts resulting from climate change, climate variation, and ocean acidification cannot be quantified at this time, nor is the exact timeframe known in which these impacts will occur. However, projections based on the Intergovernmental Panel on Climate Change's Special Report on Emissions Scenarios give a reduction in average global surface ocean pH of between 0.14 and 0.35 units during the 21st century (Climate Change 2007).

The action and the alternatives proposed in this amendment are not expected to increase or decrease the potential impacts of global climate change and ocean acidification on fishery resources and other protected resources. Other anthropogenic impacts to reef fish, spiny lobster, coral resources, and queen conch in the affected area may be more pressing than climate change. Continued monitoring of the effects of climate change and ocean acidification should continue to be a priority of national and local programs. For more information about climate impacts in U.S. marine living resources concerning NMFS, see Osgood (2008). For additional information about climate change in the Caribbean and Southeast region, please see Chapter 17 of the Third National Climate Assessment: *Climate Change Impacts in the United States*; http://nca2014.globalchange.gov/report/regions/southeast, (Carter et al. 2014).

7) Define a baseline condition for the resources, ecosystems, and human communities.

The purpose of defining a baseline condition for the resource and ecosystems in the area of the proposed action is to establish a point of reference for evaluating the extent and significance of expected cumulative effects.

For a detailed discussion of the baseline condition of the three areas, please see García-Sais et al. 2010 (Abrir La Sierra Bank), García-Sais et al. 2007 (Bajo de Sico), and García-Sais et al. 2013 (Tourmaline Bank). These documents outline the outcomes of research conducted in Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank and provide extensive information on the condition of each area.

For a detailed discussion of the baseline condition of U.S. Caribbean reef fish and spiny lobster, please see the 2005 Caribbean SFA Amendment (CFMC 2005), the 2010 Caribbean ACL Amendment (CFMC 2011a), and the history of management and biological environment sections of this regulatory amendment (Sections 1.5 and 3.2, respectively). The information included in CFMC (2011a) and CFMC (2011b) was reviewed and found to be relevant. Section 5.2.1 of the Caribbean SFA Amendment and Section 5.2.2 of the 2010 Caribbean ACL Amendment describe baseline biological conditions for Caribbean spiny lobster and reef fish, respectively, including biology and life history. Section 1.5 of this regulatory amendment and environmental assessment provides a description of the history of management in federal waters for reef fish and spiny lobster. Section 3.2.1 describes the biology and ecology of a representation of the reef

fish found in the managed areas as well as spiny lobster. Section 3.3 provides a description of the economic and social communities of the west coast of Puerto Rico.

Protected species in the affected environment are described in Section 3.2.2 of this regulatory amendment, and include sea turtles, marine mammals, and corals. The status and health of EFH for Caribbean resources has been extensively described (CFMC 1998, 2004, 2011c). The Council, NMFS, and other federal agencies have designated numerous areas in the Caribbean to protect and conserve EFH. These areas protect EFH from a wide variety of direct impacts, including loss of fishing gear, restricted use of certain fishing gears, and damage from anchors.

8) Identify the important cause-and-effect relationships between human activities and resources, ecosystems, and human communities (Table 4.3.1).

Table 4.6.1. The cause-and-effect relationship of establishing/modifying the seasonal closures and regulatory actions within the time period of the Cumulative Effects Assessment (CEA).

Time Period /Dates	Cause (Management Action)	Observed and/or Expected Effects
Effective date May 1993	**Reef Fish Amendment 2 (CFMC 1993)** 1) Established seasonally closed area (all fishing prohibited from December 1 through end of February, each year) a. Tourmaline Bank A 18°11.2' N 67°22.4' W B 18°11.2' N 67°19.2' W C 18°08.2' N 67°19.2' W D 18°08.2' N 67°22.4' W A 18°11.2' N 67°22.4' W	Reduce mortality of red hind and other reef fish. Protect spawning reef fish during spawning aggregations
Effective date August 1996	**Reef Fish Regulatory Amendment 2 (CFMC 1996)** 1) Modified the size of Tourmaline Bank (to allow for the use of the sandy area where red hind are not found). 2) Established two more seasonally closed areas (all fishing prohibited from December 1 through end of February, each year) a. Abrir La Sierra A 18°06.5' N 67°26.9' W B 18°06.5' N 67°23.9' W C 18°03.5' N 67°23.9' W D 18°03.5' N 67°26.9' W A 18°06.5' N 67°26.9' W b. Bajo de Sico A 18° 15.7' N 67° 26.4' W B 18° 15.7' N 67° 23.2' W C 18° 12.7' N 67° 23.2' W D 18° 12.7' N 67° 26.4' W A 18° 15.7' N 67° 26.4' W	Restoring and maintaining adult stocks at levels that ensure adequate spawning and recruitment to replenish the population. Preventing the harvest of individuals of species of high value (e.g., snappers, groupers, and others).

Time Period /Dates	Cause (Management Action)	Observed and/or Expected Effects
Effective date May 2005	**Reef Fish Amendment 3 (CFMC 2005)** 1) Prohibited the year-round use of bottom tending gear (traps, pots, gillnets, trammel nets, bottom longlines) in the seasonally closed areas including Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank.	Prevent, mitigate, or minimize adverse fishing impacts to bottom habitat, including corals.
Effective date December 2010	**Reef Fish Regulatory Amendment 3 (CFMC 2010)** 2) Modified the length of the seasonal closure of Bajo de Sico to 6 months (October 1 through March 31). 3) Prohibited fishing for or possession of Council-managed reef fish within the EEZ portion of Bajo de Sico. 4) Prohibited anchoring year-round within Bajo de Sico.	Reduce fishing mortality of red hind and other reef fish. Allowed the harvest of spiny lobster and HMS species Prevent interactions between anchors and bottom habitat

9) Determine the magnitude and significance of cumulative effects.

The management actions in this regulatory amendment (Chapter 2) propose to modify the seasonal closures of Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. Because the areas are off the west coast of Puerto Rico, the actions would affect the Puerto Rico management area. Although Bajo de Sico and Tourmaline Bank both include portions in federal waters as well as in Puerto Rico Commonwealth waters, the effects of the proposed actions only pertain to the federal portions of these areas.

The overarching goal of this proposed modification is to establish consistent regulations governing the three target areas as a means of ensuring protection of spawning aggregations of reef fish and the benthic habitat supporting those aggregations, which also serves as residential, recruitment, and foraging habitat for a variety of species. An additional objective of the proposed action is to achieve regulatory consistency among the three areas, thereby facilitating enforcement of those regulations. Within that overarching goal, the Council proposes six actions. Action 1 proposes to modify the timing of the established seasonal fishing closures to enhance protection of known reef fish spawning aggregations in an effort to achieve a more natural sex ratio, age, and size structure, while minimizing adverse social and economic effects. Actions 2 and 3 propose to modify the reef fish and spiny lobster fishing activities, respectively, within Abrir La Sierra Bank, Bajo de Sico, and Tourmaline Bank. Action 4 proposes to prohibit anchoring in order to protect benthic habitats, including pristine coral stands. Action 5 proposes

to modify the Atlantic HMS fishing activities within the three managed areas. Action 6 proposes to modify the spearfishing regulations within the three areas.

Chapter 4 of this document discusses the magnitude and significance of the proposed actions and alternatives on the Caribbean resources. Modifying the seasonal closures is expected to result in minor impacts to the physical, biological, and social environments. Those impacts will depend on which alternative the Council selects for each action. A more thorough analysis of each impact will be completed after the Council selects preferred alternatives. However, none of the alternatives are expected to cause or contribute to significant direct or indirect impacts.

An indirect effect expected from this action could be an increase in the harvest of species outside the managed areas as fishermen could decide to mitigate for the loss of fishing opportunities for reef fish, spiny lobster, and/or HMS species resulting from modifying the seasonal closures. However, each resource is managed under trip/bag limits and ACLs, thus additional impacts on these species are not expected to be significant.

10) Modify or add alternatives to avoid, minimize, or mitigate significant cumulative effects.

The modification of the seasonal closures in this regulatory amendment is not expected to directly adversely affect the physical, ecological, biological, economic, or social environments, and is not expected to have significant cumulative effects, therefore there is no need to modify or add alternatives to avoid, minimize, or mitigate significant cumulative effects. In summary, modifying the closed seasons adds a short-term administrative burden to promulgate the required regulations. The proposed action would result in additional short-term administrative burdens for law enforcement officers to incorporate the new changes into the regulations (e.g. training agents). However, consistent regulations would result in a number of positive long-term benefits by alleviating confusion among enforcement officers and user-groups. Other positive long-term benefits include increased protection if the seasonal closures are extended (Action 1), spearfishing is prohibited (Action 2), and anchoring is prohibited (Action 4).

Although developing regulations to achieve consistency presents an administrative burden, the net administrative effects of establishing consistent fishing regulations in federal waters are expected to be positive. Enforcement would be facilitated due to consistent regulations, which allows for straightforward application of the law and removes confusion as an excuse for non-compliance. This would likely translate into fewer false or unsupportable citations, more effective identification and prosecution of actual violations, less wasted time in the legal system, and better understanding and compliance by the fishers. Taking no action would avoid this short administrative burden, but it would not achieve the purpose of this regulatory amendment which is to aid enforcement in the three managed areas as well as protect spawning aggregations and the habitat on which they depend. A comprehensive review of each action will be completed once the Council selects their preferred alternatives.

To ensure the managed areas are achieving the specified objectives, periodic reviews are needed. These reviews are designed to incorporate new information and to address unanticipated developments in the fisheries and would be used to make appropriate adjustments in the regulations, as needed.

11) Monitor the cumulative effects of the selected alternative and adopt management.

To be completed.

Chapter 5. List of Preparers

Table 5.1. List of Interdisciplinary Plan Team Members.

Name	Agency	Title
Juan Agar	SEFSC	Economist
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Graciela Garcia-Moliner	CFMC	IPT Co-Lead/Fishery Biologist
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Andrew Herndon	NMFS/PR	Fishery Biologist (Protected Resources)
Denise Johnson	NMFS/SF	Economist
David Keys	NMFS/SER	Regional NEPA Coordinator
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Miguel Lugo	NMFS/SF	Fishery Biologist
Christina Package-Ward	NMFS/SF	Anthropologist
Rick Pearson	NMFS/HMS	Fishery Management Specialist
Kate Quigley	CFMC	Economist
Lynn Rios	NMFS/OLE	Criminal Investigator
Jose Rivera	NMFS/HC	EFH Specialist

CFMC = Caribbean Fishery Management Council
GC = General Counsel
HC = Habitat Conservation Division
HMS = Highly Migratory Species
NEPA = National Environmental Policy Act
NMFS = National Marine Fisheries Service
OLE = Office of Law Enforcement
PR = Protected Resources Division
SEFSC = Southeast Fisheries Science Center
SF = Sustainable Fisheries Division

Chapter 6. List of Agencies and Persons Consulted

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List of Agencies, Organizations, and Persons Consulted

Department of Commerce Office of General Counsel
National Marine Fisheries Service Office of General Counsel
National Marine Fisheries Service Office of General Counsel Southeast Region
National Marine Fisheries Service Southeast Regional Office
National Marine Fisheries Service Southeast Fisheries Science Center
National Marine Fisheries Service Silver Spring Office
National Marine Fisheries Service Office of Law Enforcement
National Marine Fisheries Service Office of Law Enforcement Southeast Division
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United States Coast Guard
United States Fish and Wildlife Service
United States Army Corps of Engineers
United States Department of the Interior
United States Department of Homeland Security
United States Department of State
United States Environmental Protection Agency Headquarters
United States Environmental Protection Agency New York Region
United States Environmental Protection Agency U.S. Virgin Islands Field Office
Marine Mammal Commission
Caribbean Environmental Protection Division
Division of Coastal Zone Management
USVI Department of Planning and Natural Resources Division of Fish and Wildlife
USVI Department of Planning and Natural Resources St. Thomas Office
USVI Department of Planning and Natural Resources St. Croix Office
Puerto Rico Department of Natural and Environmental Resources
Puerto Rico Department of Agriculture
Puerto Rico Junta de Calidad Ambiental (Environmental Quality Board)
Puerto Rico Junta de Planificación (Planning Board)

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Appendix A: List of Reef Fish Species

Lutjanidae--Snappers

Unit 1

Black snapper, *Apsilus dentatus*
Blackfin snapper, *Lutjanus buccanella*
Silk snapper, *Lutjanus vivanus*
Vermilion snapper, *Rhomboplites aurorubens*
Wenchman, *Pristipomoides aquilonaris*

Unit 2

Cardinal, *Pristipomoides macrophthalmus*
Queen snapper, *Etelis oculatus*

Unit 3

Gray snapper, *Lutjanus griseus*
Lane snapper, *Lutjanus synagris*
Mutton snapper, *Lutjanus analis*
Dog snapper, *Lutjanus jocu*
Schoolmaster, *Lutjanus apodus*
Mahogany snapper, *Lutjanus mahogoni*

Unit 4

Yellowtail snapper, *Ocyurus chrysurus*

Serranidae--Sea basses and Groupers

Unit 1

Nassau Grouper, *Epinephelus striatus*

Unit 2

Goliath grouper, *Epinephelus itajara*

Unit 3

Coney, *Epinephelus fulvus*
Graysby, *Epinephelus cruentatus*
Red hind, *Epinephelus guttatus*
Rock hind, *Epinephelus adscensionis*

Unit 4

Black grouper, *Mycteroperca bonaci*
Red grouper, *Epinephelus morio*
Tiger grouper, *Mycteroperca tigris*
Yellowfin grouper, *Mycteroperca venenosa*

Unit 5

Misty grouper, *Epinephelus mystacinus*
Yellowedge grouper, *Epinephelus flavolimbatus*

Haemulidae--Grunts

White grunt, *Haemulon plumierii*

Margate, *Haemulon album*
Tomtate, *Haemulon aurolineatum*
Bluestriped grunt, *Haemulon sciurus*
French grunt, *Haemulon flavolineatum*
Porkfish, *Anisotremus virginicus*

Mullidae--Goatfishes
Spotted goatfish, *Pseudupeneus maculatus*
Yellow goatfish, *Mulloidichthys martinicus*

Sparidae--Porgies
Jolthead porgy, *Calamus bajonado*
Sea bream, *Archosargus rhomboidalis*
Sheepshead porgy, *Calamus penna*
Pluma, *Calamus pennatula*

Holocentridae--Squirrelfishes
Blackbar soldierfish, *Myripristis jacobus*
Bigeye, *Priacanthus arenatus*
Longspine squirrelfish, *Holocentrus rufus*
Squirrelfish, *Holocentrus adscensionis*

Malacanthidae--Tilefishes
Blackline tilefish, *Caulolatilus cyanops*
Sand tilefish, *Malacanthus plumieri*

Carangidae--Jacks
Blue runner, *Caranx crysos*
Horse-eye jack, *Caranx latus*
Black jack, *Caranx lugubris*
Almaco jack, *Seriola rivoliana*
Bar jack, *Caranx ruber*
Greater amberjack, *Seriola dumerili*
Yellow jack, *Caranx bartholomaei*

Scaridae--Parrotfishes
Blue parrotfish, *Scarus coeruleus*
Midnight parrotfish, *Scarus coelestinus*
Princess parrotfish, *Scarus taeniopterus*
Queen parrotfish, *Scarus vetula*
Rainbow parrotfish, *Scarus guacamaia*
Redfin parrotfish, *Sparisoma rubripinne*
Redtail parrotfish, *Sparisoma chrysopterum*
Stoplight parrotfish, *Sparisoma viride*
Redband parrotfish, *Sparisoma aurofrenatum*
Striped parrotfish, *Scarus croicensis*

Acanthuridae--Surgeonfishes
- Blue tang, *Acanthurus coeruleus*
- Ocean surgeonfish, *Acanthurus bahianus*
- Doctorfish, *Acanthurus chirurgus*

Balistidae–-Triggerfishes
- Ocean triggerfish, *Canthidermis sufflamen*
- Queen triggerfish, *Balistes vetula*
- Sargassum triggerfish, *Xanthichthys ringens*

Monacanthidae-–Filefishes
- Scrawled filefish, *Aluterus scriptus*
- Whitespotted filefish, *Cantherhines macrocerus*
- Black durgon, *Melichthys niger*

Ostraciidae--Boxfishes
- Honeycomb cowfish, *Lactophrys polygonia*
- Scrawled cowfish, *Lactophrys quadricornis*
- Trunkfish, *Lactophrys trigonus*
- Spotted trunkfish, *Lactophrys bicaudalis*
- Smooth trunkfish, *Lactophrys triqueter*

Labridae--Wrasses
- Hogfish, *Lachnolaimus maximus*
- Puddingwife, *Halichoeres radiatus*
- Spanish hogfish, *Bodianus rufus*

Pomacanthidae--Angelfishes
- Queen angelfish, *Holacanthus ciliaris*
- Gray angelfish, *Pomacanthus arcuatus*
- French angelfish, *Pomacanthus paru*

Aquarium Trade Species in the Caribbean Reef Fish FMP:
- Frogfish, *Antennarius spp.*
- Flamefish, *Apogon maculatus*
- Conchfish, *Astrapogon stellatus*
- Redlip blenny, *Ophioblennius atlanticus*
- Peacock flounder, *Bothus lunatus*
- Longsnout butterflyfish, *Chaetodon aculeatus*
- Foureye butterflyfish, *Chaetodon capistratus*
- Spotfin butterflyfish, *Chaetodon ocellatus*
- Banded butterflyfish, *Chaetodon striatus*
- Redspotted hawkfish, *Amblycirrhitus pinos*
- Flying gurnard, *Dactylopterus volitans*
- Atlantic spadefish, *Chaetodipterus faber*

Neon goby, *Gobiosoma oceanops*
Rusty goby, *Priolepis hipoliti*
Royal gramma, *Gramma loreto*
Creole wrasse, *Clepticus parrae*
Yellowcheek wrasse, *Halichoeres cyanocephalus*
Yellowhead wrasse, *Halichoeres garnoti*
Clown wrasse, *Halichoeres maculipinna*
Pearly razorfish, *Hemipteronotus novacula*
Green razorfish, *Hemipteronotus splendens*
Bluehead wrasse, *Thalassoma bifasciatum*
Chain moray, *Echidna catenata*
Green moray, *Gymnothorax funebris*
Goldentail moray, *Gymnothorax miliaris*
Batfish, *Ogcocephalus spp.*
Goldspotted eel, *Myrichthys ocellatus*
Yellowhead jawfish, *Opistognathus aurifrons*
Dusky jawfish, *Opistognathus*
Cherubfish, *Centropyge argi*
Rock beauty, *Holacanthus tricolor*
Sergeant major, *Abudefduf saxatilis*
Blue chromis, *Chromis cyanea*
Sunshinefish, *Chromis insolata*
Yellowtail damselfish, *Microspathodon chrysurus*
Dusky damselfish, *Pomacentrus fuscus*
Beaugregory, *Pomacentrus leucostictus*
Bicolor damselfish, *Pomacentrus partitus*
Threespot damselfish, *Pomacentrus planifrons*
Glasseye snapper, *Priacanthus cruentatus*
High-hat, *Equetus acuminatus*
Jackknife-fish, *Equetus lanceolatus*
Spotted drum, *Equetus punctatus*
Scorpaenidae--*Scorpionfishes*
Butter hamlet, *Hypoplectrus unicolor*
Swissguard basslet, *Liopropoma rubre*
Greater soapfish, *Rypticus saponaceus*
Orangeback bass, *Serranus annularis*
Lantern bass, *Serranus baldwini*
Tobaccofish, *Serranus tabacarius*
Harlequin bass, *Serranus tigrinus*
Chalk bass, *Serranus tortugarum*
Caribbean tonguefish, *Symphurus arawak*
Seahorses, *Hippocampus spp.*
Pipefishes, *Syngnathus spp.*
Sand diver, *Synodus intermedius*
Sharpnose puffer, *Canthigaster rostrata*
Porcupinefish, *Diodon hystrix*